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COMMUNICATIONS PROBLEMS IN MARINE CASUALTIES

FINAL REPORT
OCTOBER 2000

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16. Abstract

The present study developed casualty investigation procedures that focused on communications problems. These procedures were applied by U.S. Coast Guard (USCG) Investigating Officers in their investigation of 589 marine casualties over a seven-month period. Analysis of the resulting casualty reports determined that communications is a prevalent causal factor in marine casualties, being a factor in 18 percent of critical vessel casualties, 28 percent of critical personnel injuries, and contributing to 19 percent of critical marine casualties overall. The investigations procedures also identified characteristics and causes of communications problems. The single largest problem involved mariners who did not communicate when appropriate. Two types of faulty assumptions were usually the cause of this: they either misinterpreted the situation and did not perceive a threat, or they incorrectly assumed that others were aware of the problem and would take care of it. Training in developing team situation awareness is suggested to combat the first problem. Better crew resource management, specifically empowering crewmembers to speak up when a threat is perceived, would correct the second problem and potentially reduce communications-related casualties by 29 percent.

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We are most grateful to the Senior Investigating Officers and the Investigating Officers from the U.S. Coast Guard Marine Safety Offices at Portland, Oregon; New Orleans, Louisiana; Paducah, Kentucky; and New York, New York. These individuals provided useful comments regarding the investigation and reporting procedures, and substantial time and effort to investigate and report casualties.

Dr. Alice Barnes carefully reviewed and edited this report. Ms. Judy Panjeti prepared the final version of this report.

We are especially thankful to Ms. Susan Czarny, who provided her significant skills and good humor in preparing forms, instructions, training materials, and reports during earlier periods of this study.

EXECUTIVE SUMMARY

It is estimated that human error contributes to between 75 and 96 percent of marine casualties (U.S. Coast Guard, 1995A). In order to identify strategies to reduce the likelihood of casualties resulting from human error, we must first gain a better understanding of the nature and causes of these casualties. The U.S. Coast Guard (USCG) has historically investigated marine casualties for cause; however, procedures for investigating, reporting, and analyzing *human factors* causes is a more recent initiative. A recent study demonstrated the value of developing and implementing investigation and reporting procedures that focused on a single human factors topic (fatigue) for use by USCG investigators (McCallum, Raby, & Rothblum, 1996). The present study was conducted to investigate the suitability of this focused approach for investigating the role of inadequate communications in marine casualties. In addressing this goal, two study objectives were identified:

- Develop a method for the focused investigation and reporting of communications problems in marine casualties.
- Identify the characteristics and underlying causes of communications problems.

The topic of communications was selected based on an earlier study which showed it was an important contributor to marine casualties. Communications investigation and reporting procedures were developed, and USCG Investigating Officers (IOs) received initial training in the investigation and reporting procedures during August and October 1997. A total of 29 IOs from four Marine Safety Offices (MSOs) supported this study by investigating and reporting on 589 marine casualties during the seven-month period from September 1, 1997, through March 31, 1998. A final assessment of the investigation and reporting procedures was conducted with IOs from each participating MSO in May 1998.

The procedures for investigating communications-related casualties were based on a model of communications processes, problem areas, and contributing factors. The model divides communications into four processes (*Prepare and Send Message*, *Message Transmission*, *Receive and Interpret Message*, and *Act on Message*) and four corresponding communications problem areas. Sixteen individual communications problems were defined within these four problem areas. The model further identifies seven general contributing factor areas that can cause or contribute to a communications problem (*Knowledge or Experience*, *Procedures*, *Performance*, *Assumptions*, *Environment*, *Communication Equipment*, and *Management and Government Regulations*). Thirty-four individual contributing factors were defined within these seven areas.

The procedures for investigating and reporting communications problems in marine casualties included a general casualty screening form and separate forms for reporting on the nature of communications problems in each of five operational areas: vessel-vessel, bridge-pilot, vessel-shore authority, crew-crew, and vessel-shore worker. The procedures consisted of a progressive, three-step series of casualty review and screening: (1) casualty criticality screening (a screening

method already used by MSOs to determine which casualties warrant a full investigation); (2) human factors contribution screening (to determine which of the critical casualties appear to have a direct human factors cause); and (3) communications operational area identification, investigation, and reporting. Feedback from IOs indicated that the procedures were useable and facilitated more accurate characterization of communications problems.

Overall, communications problems were associated with 18 percent of all critical vessel casualties and 28 percent of all critical personnel injuries (19 percent of critical casualties overall). The communications screening procedure was found to be quick and easy to use and effective: among the 50 critical casualties identified through the screening procedure as having a potential for communications, 38 cases (76 percent) were found to have a contributing communications problem.

The analysis of communications problems revealed striking similarities among the vessel and personnel injury cases. Among both types of casualties, the most prevalent communications process problem was *Prepare and Send Message*; problems in this area contributed to 87% of the communications-related casualties. This problem area was most frequently cited in crew-crew, vessel-vessel, and pilot-bridge communications. A failure to initiate needed communications was identified as the most common specific problem, and contributed to 68% of the communications-related casualties. Several contributing factors were cited as leading to problems in preparing and sending messages, with incorrect assumptions regarding the need to communicate as the most prevalent general factor among both critical vessel and critical personnel injury casualties. In this subset, the most frequently cited incorrect assumption was that there was no need to communicate. An incorrect interpretation of the situation and the incorrect assumption that someone else recognized the danger and would take action were two other frequent causes for not initiating communications.

A meta-analysis of the reasons behind these failures to communicate led to the conclusion that in almost all these situations, at least one mariner did not recognize that a dangerous situation was unfolding that required him to take action (communicate with others). Methods for improving crew situation awareness would help eliminate this problem. A second discovery was that in almost half of the "did not communicate" casualties, there was a different crew member who *did* recognize the threat, but who still *did not speak up*, generally because he thought (incorrectly) someone else was also aware of the problem. Training and implementation of crew resource management is highly recommended as a way to instill a responsible and participatory attitude among crewmembers and to empower them to speak up whenever a potential threat is perceived.

The set of communications screening procedures could be adopted as a tool for identification of cases that are likely to involve communications problems. The set of follow-up questions that is included in each communications operational area reporting form could be used by IOs in identifying specific communications problems and underlying causal factors. The revised and streamlined set of investigation procedures is provided in Appendix D. In addition, along with the present findings, the communications process model and contributing factors developed as part of this study could be incorporated into the Coast Guard's Investigating Officer course.

The current study identified the most prevalent communications problems and contributing factors in critical vessel casualties and personnel injuries. These findings can help in establishing a framework for ameliorative actions by industry. Specifically, the single most pervasive problem found was that of mariners who did not communicate important information. It would appear that actions to improve crew situation awareness and to facilitate the sharing of information are sorely needed. As a first step in making industry aware of these problems, the findings from this project were presented at the Maritime Human Factors Conference in March, 2000.

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LIST OF ACRONYMS

IO	Investigating Officer
GRT	Gross Tons
MINMOD	Marine Investigations Module
MSIS	Marine Safety Information System
MSO	Marine Safety Office
OP	Operational
PTP	Prevention Through People
QAT	Quality Action Team
SOP	Standard Operating Procedures
USCG	United States Coast Guard

1 INTRODUCTION

It is estimated that human error contributes to between 75 and 96 percent of marine casualties (U.S. Coast Guard, 1995A). In order to identify strategies to reduce the likelihood of casualties resulting from human error, we must first gain a better understanding of the nature and causes of these casualties. The U.S. Coast Guard (USCG) has historically investigated marine accidents for cause; however, procedures for investigating, reporting, and analyzing *human factors causes* is a more recent initiative. Two recent Coast Guard Headquarters initiatives, the Prevention Through People (PTP) Quality Action Team (QAT) study (U.S. Coast Guard, 1995A) and the Marine Safety Investigations QAT study (U.S. Coast Guard, 1995B), focused on improving the Coast Guard's ability to identify human-related causes of marine casualties. The USCG Office of Investigations and Analysis is implementing recommendations from these studies. Steps that have been taken include providing introductory human factors training to Investigating Officers (IOs), and reducing the investigation of minor casualties to provide more time for a fuller investigation of critical marine casualties.

In support of the Office of Investigation and Analysis, the USCG Research and Development Center is conducting studies to develop investigation procedures and job aids to help IOs identify specific types of human error contributing to a marine casualty. The first, which focused on mariner fatigue, provided significant insight into the nature of fatigue-related marine casualties, as well as specific guidance for future investigations of fatigue in marine casualties (McCallum, *et al.*, 1996).

The present study focused on the topic of mariner communications. Communications was chosen based on an evaluation of several human factors areas relevant to marine casualties (McCallum and Raby, 1995). Communications was known to be a prevalent cause of casualties and ranked near the top of the priority list in the evaluation[1]. This report documents the development and implementation of investigation and reporting procedures designed specifically to address the role of communications in marine casualties and our findings regarding communications problems in marine casualties.

1.1 Study Objectives

The current study had two objectives:

- Develop a method for the focused investigation and reporting of communications problems that contribute to marine casualties.
- Identify the characteristics and underlying causes of maritime communications problems.

[1] The top three topics were fatigue, communications, and knowledge. All three of these topics have now been investigated.

1.2 Study Approach

The basic study approach was to develop procedures for investigating and reporting communications problems, conduct a small-scale study for a limited period of time with a sample of Marine Safety Offices (MSOs), and then analyze the resulting casualty reports. Following the success of our earlier fatigue study, we employed the same basic strategy in developing and implementing the investigation and reporting procedures. This strategy included the following:

- Limiting IOs' investigation and reporting to well-defined issues.
- Training participating IOs on the selected human factors topic (communications) and in the use of the procedures.
- Employing stand-alone reporting forms that did not require the use of the CG's casualty database (Marine Investigations Module, MINMOD), thus keeping the research independent from the operational reporting of casualties.

In order to limit the scope of this study, we set several limits on the type and number of casualties to be investigated and analyzed. First, only cases involving vessel casualties or personnel injuries were included. Second, only "critical" casualties, i.e., those associated with significant risk to property or injury to individuals, were fully investigated and reported. Third, MSO participation was limited to four offices. Finally, based on our preliminary estimates of the prevalence of human factors and communications contributions to casualties, we determined that we would require approximately 500 cases to adequately assess the value of the casualty data in these investigation reports. This led to the collection of casualty data over a seven-month period.

2 TECHNICAL APPROACH

2.1 Overview

This study began with the development of the communications investigation and reporting procedures. Investigating Officers received initial training in the investigation and reporting procedures during August and October 1997. A total of 29 IOs from four MSOs supported this study by investigating and reporting marine casualties during the seven-month period from September 1, 1997, to March 31, 1998. A final assessment of the investigation and reporting procedures was conducted with each participating MSO in May 1998. The remainder of the *Technical Approach* section describes each of these activities.

2.2 Communications Investigation and Reporting Procedures

In developing the communications investigation and reporting procedures, we adopted the basic approach that had been successful in the earlier fatigue study (McCallum, Raby, & Rothblum, 1996). Investigating Officers first conducted an initial *Screening and Background* process to collect general casualty information and to identify cases that met established criteria for further investigation of communications issues. Then, if the criteria for further investigation were met, an in-depth investigation of communications problems and contributing factors was conducted.

Figure 1 depicts the logic of the *Screening and Background* process. After determining whether the casualty was reportable, *Casualty Criticality Screening* was conducted in order to identify those cases where there was a significant risk to property or personnel safety. Those cases not meeting the criticality screening criteria were excluded from further investigation for the purposes of this study. Next, if the criticality criteria were met, *Human Factors Screening* was conducted to identify those cases where an individual's action or inaction directly contributed to the casualty.[2] Finally, for the critical human factors cases, *Communications Operational Area Identification* was conducted to determine if one or more of the five operational areas pertained to the case. If a communications operational area was determined to be pertinent, the case was further investigated to determine if communications problems contributed to the casualty and, if so, to characterize the communications problems and contributing factors. If none of the communications operational areas was determined to be pertinent, only the screening form was completed and forwarded to the research team.

[2] This captured only about half of the true human error causes, since latent errors stemming from poor policies, procedures, or maintenance errors were not considered.

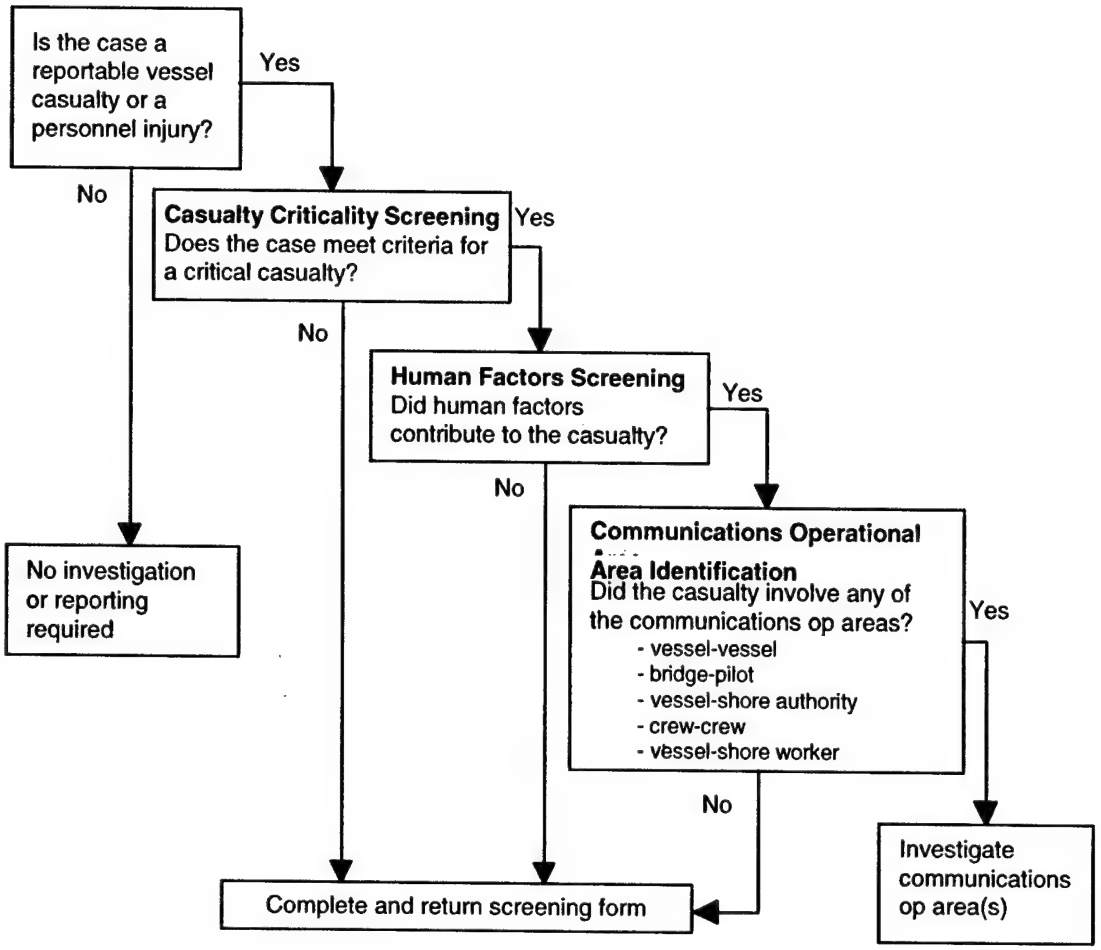

Figure 1. Summary of screening and background investigation process.

As noted above, five communications operational areas were defined, based on an analysis of marine operations communications. The five operational (op) areas were vessel-vessel communications, bridge-pilot communications, vessel-shore authority communications, crew-crew communications, and vessel-shore worker communications. The screening procedure used by IOs to determine the pertinence of each of these five op areas involved one screening question for each area. Each screening question asked whether the people who held the positions relevant to the operational area had any role in operations at the time of the casualty. For example, the sub-topic vessel-vessel communications was determined to be pertinent if the IO judged the following question to be true: *Were two or more vessels involved in the casualty?* Table 1 lists the five communications operational area screening questions.

Table 1. Communications operational areas and screening questions.

Communications Operational Area	Screening Question
Vessel-Vessel	Were two or more vessels involved in this casualty?
Bridge-Pilot	Was there a pilot, other than a member of the ship's crew, responsible for the navigation of the ship?
Vessel-Shore Authority Personnel	Was the vessel navigating in an area under the supervision of a VTS operator, a bridge tender, a lockmaster, or a light operator?
Crew-Crew	Were two or more crewmembers working together who were directly involved in the casualty, or could the casualty have been prevented if someone had shared additional information with another crewmember?
Vessel-Shore Worker	Did the casualty occur during coordination of activities between the ship and shore-based personnel (e.g., dockworker, crane operator, vessel agent)?

To help IOs better conceptualize the role of communications in marine casualties, a general model was developed. As shown in Figure 2, the model divides communications into four *communications processes* (*Prepare and Send Message, Message Transmission, Receive and Interpret Message,* and *Act on Message*) and four corresponding *communications problem areas* (problems preparing and sending messages, problems with message transmission, problems receiving and interpreting messages, and problems acting on messages). Sixteen individual problems were defined within these four problem areas. For example, the *Act on Message* problem area is comprised of two specific problems: *Took no action* and *Action was not in accordance with agreement.*

The model further identifies seven general *contributing factor areas* that can cause a communications problem (Knowledge or Experience, Procedures, Performance, Assumptions, Environment, Communication Equipment, and Management and Government Regulations). Thirty-four specific contributing factors were defined within these seven areas. For example, the area of environment (which can contribute to message transmission problems) is comprised of three specific factors: *Excessive ambient noise*, *Excessive electronic or atmospheric disruption of signal*, and *Excessive traffic on the assigned communications channel.*

Using the five reporting forms, IOs were asked to review the facts of each case where communications was a potential contributor and identify all communications problems that were evident in the casualty. They were also asked to identify between one and four factors that directly contributed to each communications problem. By determining which contributing factors were associated with individual communications problems, IOs were able to characterize the nature and likely cause of each problem. The revised reporting form in Appendix D lists the 16 communications problems and 34 contributing factors (see page D-5; note that "Other" is not considered as one of the 34 specific contributing factors).

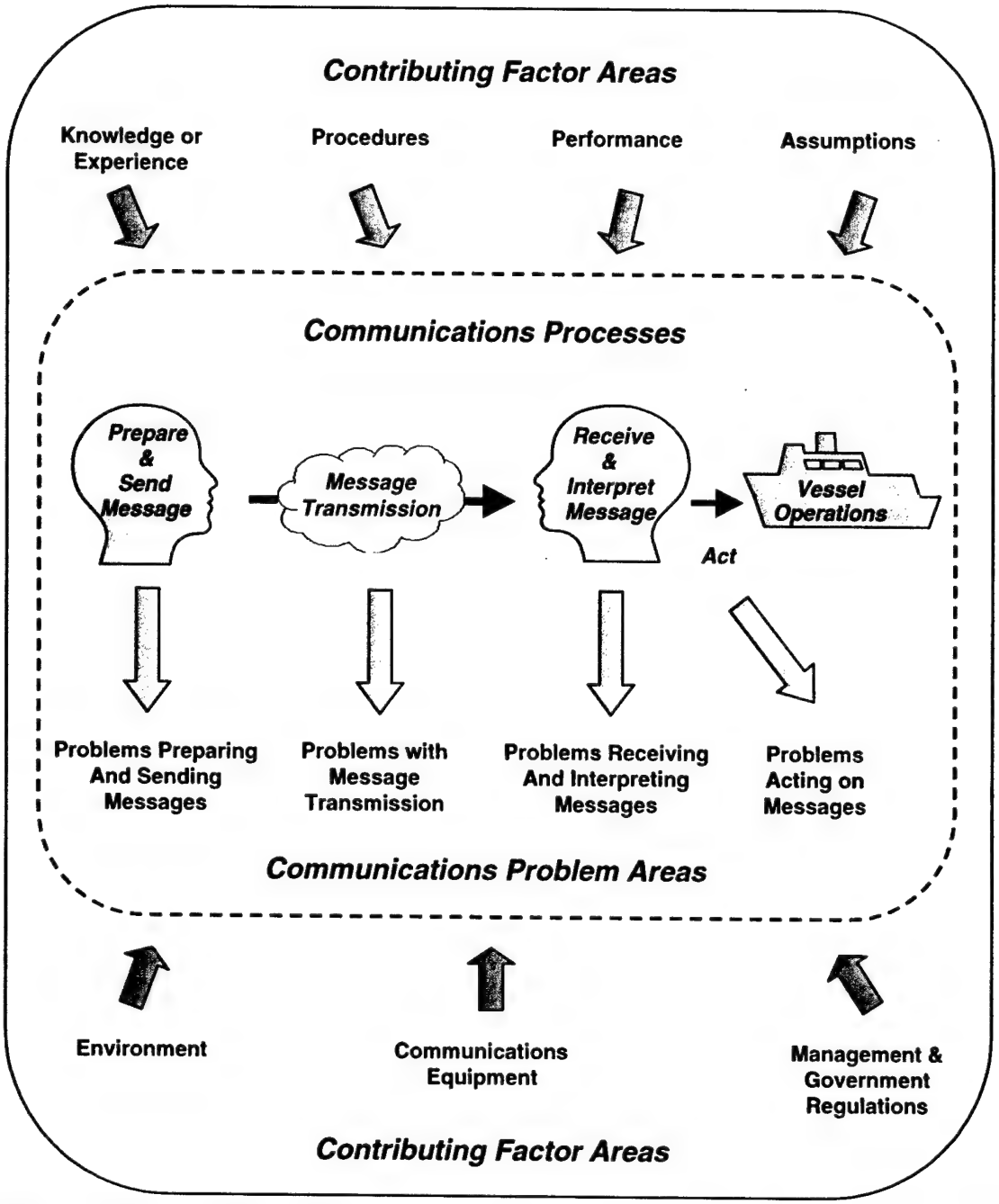

Figure 2. Model of communications processes, problem areas, and contributing factor areas.

2.3 Investigating Officer Training

Investigating Officers at each participating MSO received one day of initial training on the use of the investigation and reporting procedures and forms. The training had three main objectives:

- Introduce the purpose of this study and its objectives.
- Provide a general overview of some basic human factors and communications concepts.

- Familiarize IOs with the investigation and reporting procedures to be used in this study.

Given the short duration of training and the need to ensure IOs' proficiency with the investigation and reporting procedures, the amount of time spent on human factors concepts was limited. The majority of time was spent introducing the concepts of communications, communications processes, communications problems, contributing factors, and the investigation and reporting procedures and forms.

As part of the training, a series of practical demonstrations in using the forms was provided. Three case studies that involved marine casualties with different communications problems and contributing factors were presented. Each case was summarized, investigation requirements were identified, and sample completed reporting forms were presented and discussed. Each IO received copies of the training slides, communications forms, and the set of instructions. Appendix A contains the slides used during the training session.

2.4 Review of Reports by Research Staff

Investigating Officers at participating MSOs completed the applicable communications reporting forms for cases that occurred between September 1, 1997, and March 31, 1998. These forms and supporting materials (CG 2692 and selected portions of the MINMOD report) were sent to the research team for review and data entry. Two researchers independently reviewed the forms submitted with each case, providing independent judgments concerning the factors casualty criticality, human factors contribution, appropriate communications sub-topic to investigate, and conclusion regarding the contribution of the specific communications sub-topic to the casualty.

Following the completion of these independent reviews, the judgments of the two researchers were compared and any disagreements were identified and discussed until agreement regarding each of the above four factors was reached. If the researchers' decision differed from that of the IO, then the IO was contacted to resolve the difference of opinion and revise the form, as necessary.

Throughout the casualty investigation and reporting period, a summary of cases received, reviewer comments, and issues requiring clarification was maintained. These summary sheets were periodically sent to each participating MSO for the IOs to review and address outstanding issues. In addition, a newsletter was prepared and sent to participating MSOs twice during the investigation and reporting period to provide IOs with information regarding any procedural changes, the ongoing study schedule, and preliminary results.

2.5 Procedure Assessments

An initial assessment of the communications investigation and reporting procedures was completed approximately 60 days following initial training. Nineteen IOs participated in one-day assessment sessions that were conducted at the four participating MSOs. A group discussion addressing the adequacy of the investigation process and reporting forms took place in the morning, and individual meetings with IOs to review ongoing and completed cases were conducted in the afternoon. The group discussion addressed the investigation process, investigation strategies and difficulties, and problems encountered in completing the reporting forms. Minor modifications were made to the *Screening and Background Form* based on information gathered during the initial assessment.

Approximately six weeks after the end of the scheduled period for casualty investigation, two researchers visited each MSO for one day to obtain feedback about the study and discuss unresolved questions concerning specific cases. Fourteen IOs participated in these final reviews. During this visit, IOs were presented with a summary of preliminary findings and asked to complete a survey addressing the training sessions, support materials, casualty reporting forms, and the costs and benefits of study participation. Group discussions then addressed ways to improve the investigation, reporting, and research methods. Appendix B contains a copy of the final assessment survey, and results of selected survey questions.

2.5.1 Perceived Benefits of Study

One of the questions on the final survey addressed the potential benefits of this study to the IO and the USCG. With respect to benefits to the individual IOs, most respondents said the study gave them a heightened awareness of the potential contribution of communications to casualties. Several IOs also said the experience of participating in the study would prompt them to investigate communications more thoroughly in the future. With respect to communications issues and benefits to the USCG, IOs mentioned that the investigations for this study were more thorough than they would have been if communications had not been a focus.

2.5.2 Time Demands on Investigating Officers

As part of the reporting process, IOs were asked to indicate the time spent investigating potential communications problems and completing the reporting forms. Estimates of the additional time required for the procedures used in this study are based on the medians (50^{th} percentiles) of the IO estimates, shown in Figure 3. For the 482 cases in which communications was not investigated, the median investigation time was 10 minutes and the form completion time was 10 minutes. For the 107 cases in which communications was investigated, the median investigation time was 60 minutes and the form completion time was 30 minutes. Across all 589 cases, the median investigation time was 25 minutes and form completion time was 10 minutes. Thus, our best estimate of the additional time spent by IOs in meeting the investigation and reporting requirements associated with this study is 35 minutes per case (representing the sum of the medians of 25 minutes for additional investigation and 10 minutes for additional form completion).

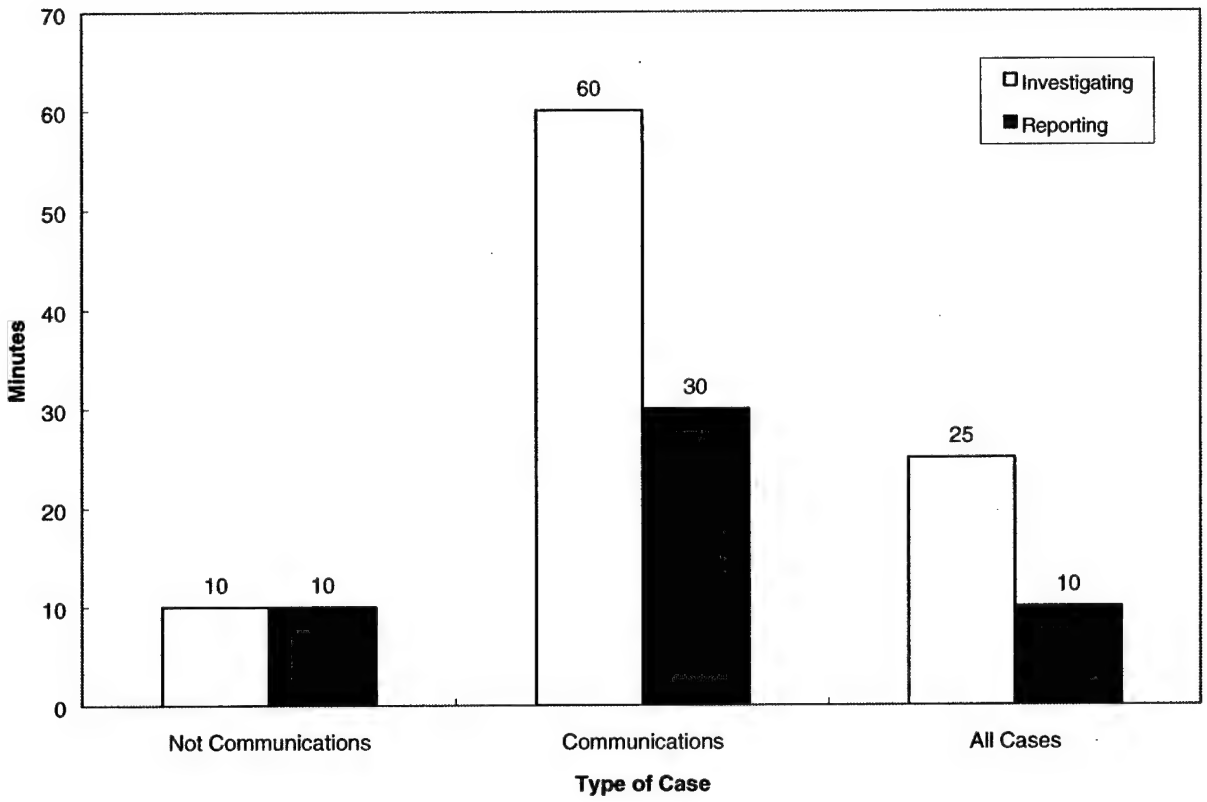

Figure 3. Median estimated time for casualty case investigation and reporting.

3 FINDINGS

This section presents the findings from our analyses of the casualty reports submitted by the Investigating Officers from the four participating Marine Safety Offices. The findings are divided into three major topics:

- General characteristics of the casualties in the study sample.
- Types of communications process problems contributing to marine casualties.
- Causes of communications process problems.

3.1 General Characteristics of the Casualties in the Study Sample

This section summarizes the characteristics of the casualties in this study. The four participating MSOs investigated and completed reports on 589 cases that occurred during the seven-month sampling period. Eighty percent (469) of these were vessel casualties, 17 percent (103) were personnel injuries, and another three percent (17) involved both a vessel casualty and a personnel injury. This trend was consistent with that found in a national sample of casualty cases at all MSOs over the same period (Eulitt, 1999). A second way to characterize the sample is to analyze the types of vessels involved in the casualties. Our sample departed from the national sample in terms of the relative number of towing vessel casualties: towing vessels were involved in 49 % of the cases in this study, whereas the national sample had towing vessels represented in only 26 % of the casualties. Our oversampling of towing vessels is probably due to the inclusion of MSO Paducah, for which towing vessel casualties made up 93 % of the cases at that MSO. Compared to the national sample, our study may underrepresent passenger vessel casualties (10 % of our sample, compared to 24 % of the national sample). Most other vessel types were fairly comparable between the two studies.

Investigating Officers screened (and the human factors researchers reviewed) each of the 589 cases to determine criticality and whether human factors directly contributed to the casualty. The breakdown of these cases is given in Figure 4. Non-critical casualties were those which caused so little damage that the CG would not routinely investigate them. Minor casualties were defined as those involving limited property damage with no risk to the loss of the vessel or personnel injury. Many of these involved a transient loss of steering or propulsion, but since the vessel and crew never appeared to be at risk, these minor casualties were considered "near misses" and not included in the detailed analyses (Appendix C provides some cursory analyses that include minor casualties). The focus of this study was on critical casualties, those involving significant damage to the vessel or property, or in which the safety of the crew was at risk. As shown in Figure 4, 200 cases met the criteria for critical casualties. Of these, 99 cases (49%) were determined to have a direct human factors contribution. A "direct" human factors contribution was defined as a decision, action, or inaction which directly contributed to the casualty (i.e., was a proximal cause). Thus, latent human errors (such as management policies, maintenance errors, etc.) were excluded because it was felt that such errors would not be readily apparent during a casualty investigation.

There was a marked difference in the percentages of vessel casualties vs. personnel injuries which had a direct human factors contribution. Sixty-three (40%) of the 157 critical vessel-only

casualties had a direct human factors contribution, while 33 (85%) of the 39 critical injury-only casualties did so. Three of the four critical cases in which both a vessel casualty and a personnel injury occurred had a direct human factors contribution. Human factors contributions were found in all types of vessel casualties, particularly in collisions, allisions, and groundings, where they accounted for the vast majority of these cases. Direct human factors was also important in founderings and sinkings, contributing to about half of those cases. Almost every type of personnel injury was associated with a direct human factors contribution. Human factors-related casualties were also found for every vessel type.

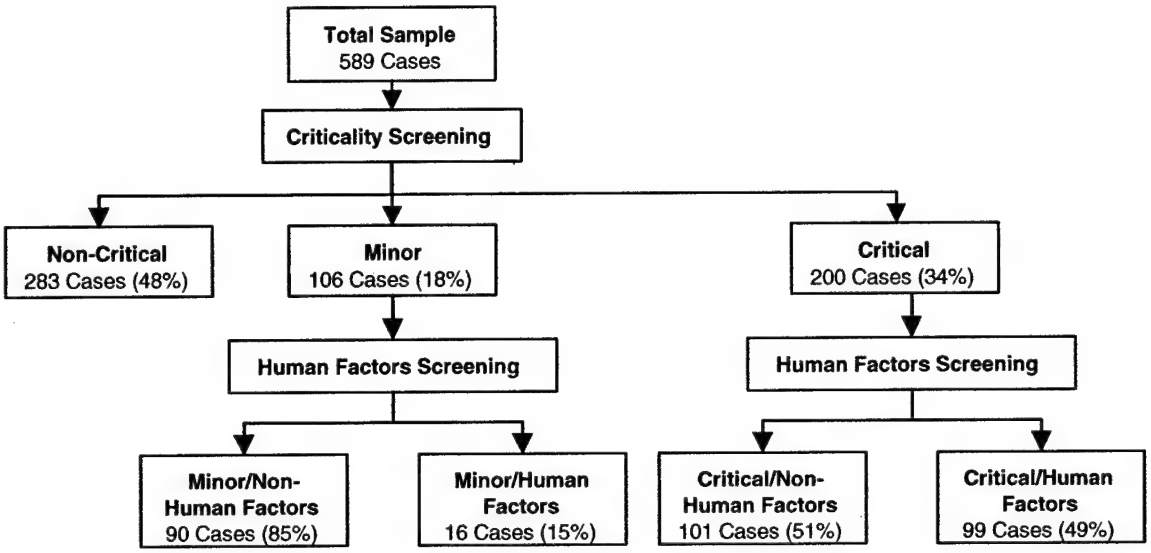

Figure 4. Summary of casualty criticality screening and human factors screening results.

3.2 Characteristics of Casualties with a Communications Contribution

This section addresses the prevalence of communications problems and the nature of those problems in vessel and personnel injury casualties.

3.2.1 Prevalence of Communications Problems

Investigating Officers screened all critical, human factors-related cases to determine if there was a potential for a communications problem. This was done using the five operational area (vessel-vessel, bridge-pilot, etc.) screening questions already described in Section 2.2. If the case had a potential for a communications problem, then a complete investigation was performed to determine whether communications contributed to the casualty.

Figure 5 summarizes the results of the screening for potential communications contribution and the final determination regarding the contribution of communications to each casualty. Of the 99 critical human factors cases, 50 cases were determined to have the potential for communications

involvement. Of these 50 cases, 38 (76 percent) were determined to have one or more communications problems contributing to the casualty.

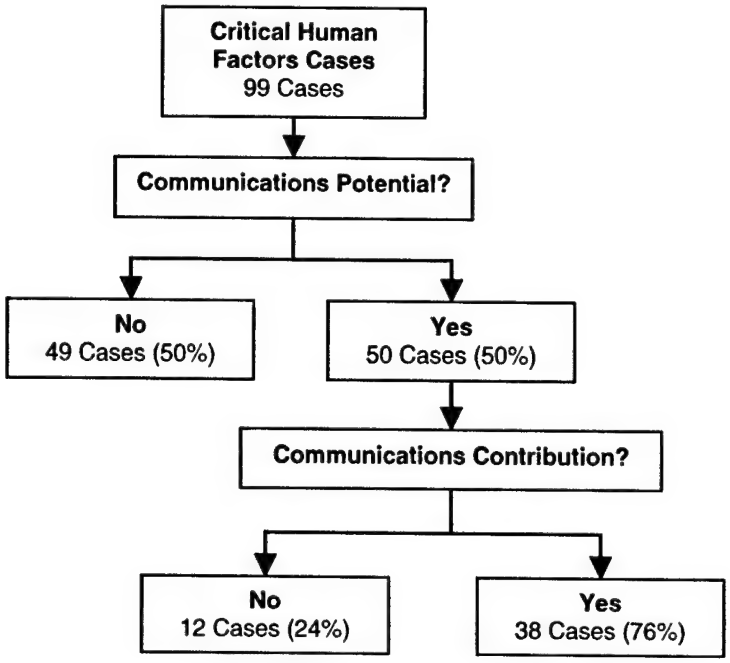

Figure 5. Summary of communications potential screening and communications investigation results.

As shown in Figure 6, the contribution of communications was comparable for vessel and personnel injury casualties. In vessel casualties with the potential for a communications contribution, communications problems contributed to 29 of the 37 cases (78 percent)[3]. In personnel injuries with the potential for a communications contribution, 12 of the 16 cases (75 percent)[4] were determined to have a communications problem. Overall, 19 percent of all critical casualties were determined to have a communications problem that contributed to the casualty. In critical vessel casualties and personnel injuries, the percentages of communications-related casualties were 18 percent and 28 percent, respectively.

[3] Total vessel casualties include the "Vessel Only" and "Vessel and Personnel" casualties as shown in Fig. 14.

[4] Total personnel injuries include the "Personnel Only" and "Vessel and Personnel" casualties as shown in Fig. 14.

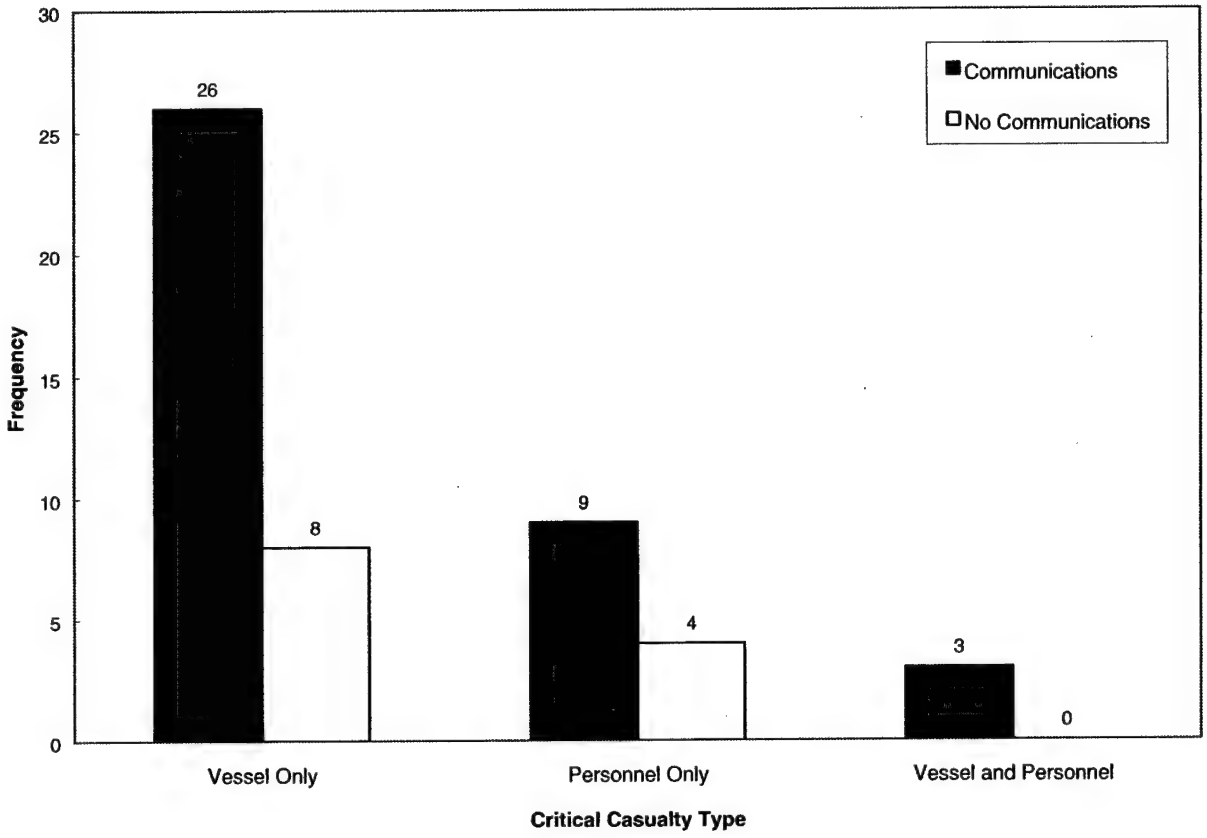

Figure 6. Frequency of critical casualty types with and without communications problems.

3.2.2 Types of Communications Problems in Marine Casualties

The following discussion addresses communications problems identified among 29 critical vessel casualties and 12 critical personnel injuries (including three cases that involved both a vessel casualty and personnel injury). Multiple communications problems were identified for most casualties. Because of this, the discussions on vessel and personnel injury casualties focus on the relative prevalence of different problems, rather than the percentage of cases in which different types of problems were cited. This is followed by a discussion on the important communications problems in marine casualties as a whole, showing the percentage of casualty cases with the different types of communications problems.

Communications problem areas in vessel casualties. Among the 29 critical vessel casualties in which communications problems were identified as a contributor, IOs identified 58 separate instances of problems. Figure 7 presents the distribution of these 58 problems across the five maritime operational areas (vessel-vessel, bridge-pilot, vessel-shore authority, crew-crew, and vessel-shore worker) and the four communications processes (*Prepare and Send Message, Message Transmission, Receive and Interpret Message,* and *Act on Message*). This figure depicts two findings worthy of note. First, there is a definite clustering of problems within communications processes. The *Prepare and Send Message* process has the majority of problems associated with it, with 33 (57 percent) of the total set of 58 cited problems. This process was the predominant source of communications problems in all five operational areas[5]. The *Receive and Interpret Message* process has 13 problems associated with it, or 22 percent of the total set of cited problems.

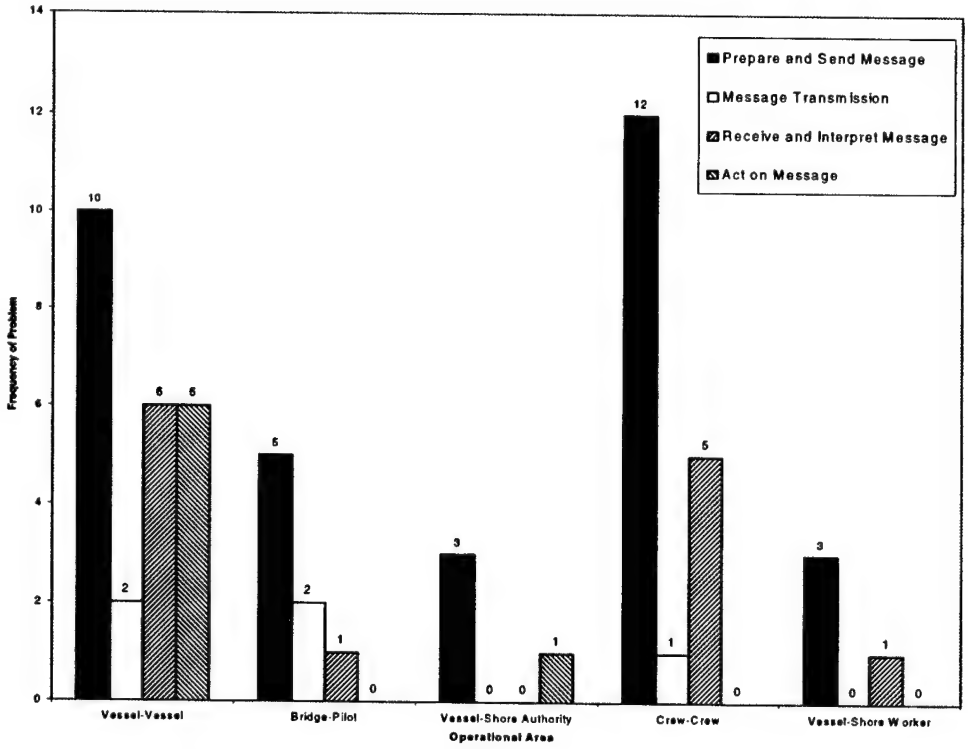

Figure 7. Critical vessel casualties – Communications process problems across five maritime operational areas.

[5] The five operational areas are shown to identify any differences in the types of communications problems which affect them. While the sample size in the present study (38 communications-related casualties) is too small to allow such an analysis, this type of analysis is recommended once a larger sample of casualties has been collected.

The second noteworthy characteristic of Figure 7 is that six combinations of communications process and operational area represent 44 (76 percent) of all cited problem areas. These six areas constitute potential opportunities for improving communications processes to reduce the risk of vessel casualties, and are explored further in the next section.

Specific communications problems in vessel casualties. Within each problem area (e.g., *Prepare and Send Message – Vessel-Vessel*) there were multiple specific communications problems. The 44 problem areas mentioned above gave rise to 56 specific communications problems, and these are presented in Table 2. In this table, the six operations-communications combinations are listed in order of their frequency, as are the specific problems listed under each area. Note that

Table 2. Critical vessel casualties – Most frequently identified communications problems within selected operational area-communications problem area combinations.

Operational Area – Communications Problem Area / Specific Communications Problem		**Frequency**
Crew-Crew – Prepare and send message	**16**	
Did not communicate		10
Communicated ambiguous, incorrect, or incomplete information		3
Did not request information		3
Vessel-Vessel – Prepare and send message	**15**	
Did not communicate		4
Did not question other's actions or assert interpretation of situation		4
Did not request information		3
Communicated ambiguous, incorrect, or incomplete information		2
Did not send information in a timely manner		2
Vessel-Vessel – Receive and interpret message	**7**	
Did not monitor communications		5
Did not listen to complete message		1
Did not acknowledge information reception		1
Bridge-Pilot – Prepare and send message	**6**	
Did not communicate		3
Communicated ambiguous, incorrect, or incomplete information		2
Did not request information		1
Vessel-Vessel – Act on message	**6**	
Took no action		4
Action was not in accordance with agreement		2
Crew-Crew – Receive and interpret message	**6**	
Did not interpret the information correctly		3
Did not verify the validity or accuracy of the information		2
Did not acknowledge information reception		1

an IO could cite multiple communications problems within a casualty. A number of specific findings are apparent in reviewing Table 2. First, within the *Prepare and Send Message* area, *Did not communicate* was the most prevalent problem, especially among crewmembers on the same vessel. Second, a fairly broad range of specific problems in the *Prepare and Send Message*

process were cited by IOs. Third, in the *Receive and Interpret Message* area, *Did not monitor communications* was the most prevalent problem. Finally, when *Act on Message* was cited as the general problem area, a general disregard for previous communications was indicated as the problem (*Took no action* and *Action was not in accordance with agreement*).

Communications problems in personnel injuries. Among the 12 personnel injury casualties in which communications problems were identified as a contributor, 26 specific problems associated with the four communications process areas were identified by IOs. Figure 8 presents the distribution of these 26 problems across four operational areas (vessel-vessel, vessel-shore authority, crew-crew, and vessel-shore worker) and the four communications process areas (*Prepare and Send Message, Message Transmission, Receive and Interpret Message*, and *Act on Message*). Review of this figure indicates that, as with critical vessel casualties, *Prepare and Send Message* was cited as the most frequent problem area, accounting for 18 (69 percent) of all cited process area problems. And again the *Prepare and Send Message* area was the predominant source of errors in each operational area. Further review of Figure 8 shows that the

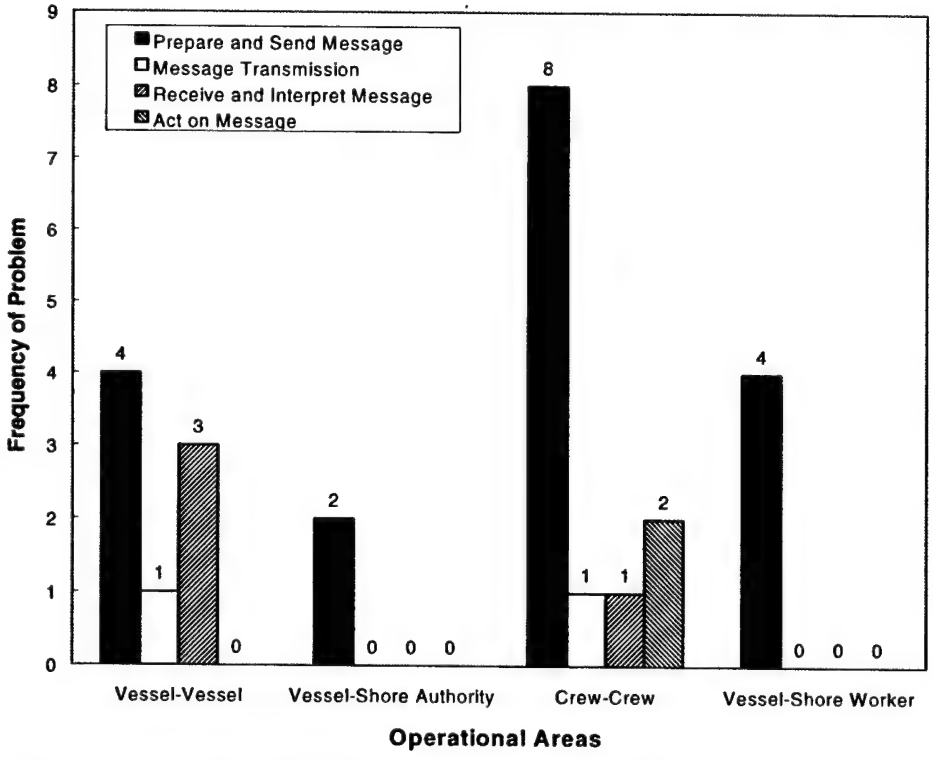

Figure 8. Critical personnel injuries – Communications problems across five maritime operational areas.

three most frequently cited combinations of operational areas and communications process areas account for 16 (62 percent) of the total 26 specific problems cited by IOs.

Most frequently identified communications problems in personnel injury casualties. The three operations-communications combinations in which specific communications problems were most frequently cited in personnel injuries are listed in Table 3, in order of their prevalence. Note that an IO could cite multiple problems within a casualty. These three combinations provide the greatest potential for improving communications processes and reducing the risk of personnel injuries resulting from similar communications problems. However, the low frequencies of problems and personnel injury cases provide limited insight into these problems. Again, there is a prevalence of the *Did not communicate* problem, accounting for 10 (63 percent) of the 16 specific problems identified among these three operational areas. Further generalizations from Table 3 are not warranted.

Table 3. Critical personnel injuries – Most frequently identified communications problems within selected operational area-communications process combinations.

Operational Area – Communications Process Specific Communications Problems	Frequency
Crew-Crew – Prepare and send message	**8**
Did not communicate	4
Communicated ambiguous, incorrect, or incomplete information	2
Did not send information in a timely manner	1
Did not request information	1
Vessel-Vessel – Prepare and send message	**4**
Did not communicate	3
Did not request information	1
Vessel-Shore worker – Prepare and send message	**4**
Did not communicate	3
Did not request information	1

Major communications process problems in marine casualties. The distribution of process problems over operational areas is quite similar for both vessel casualties and for personnel injuries. There is insufficient data to support any differences in communications problems by operational area. To get a clearer picture of the important process problems, the data were combined to show the frequency of problems in each of the four communications process areas for all casualties (Fig. 9).

Multiple communications problems were identified for most of the 38 communications-related casualties, resulting in a total of 76 communications process area problems (as shown in Fig. 9). Of these, 45 (59 percent) were *Prepare and Send Message* problems. The *Prepare and Send Message* category takes on even greater significance when we consider its frequency of

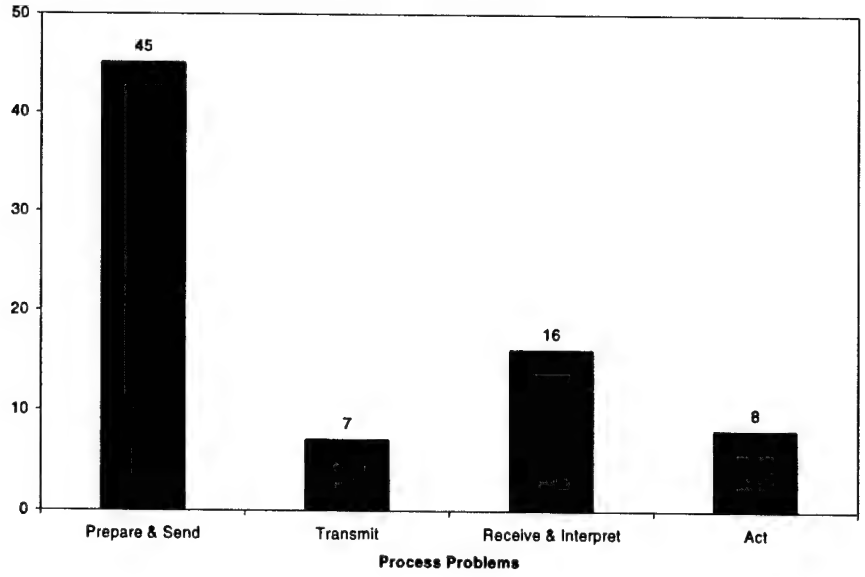

Figure 9. Frequency of communications process problems over all 38 marine casualties.

occurrence with respect to the number of casualty cases: 87 percent of the 38 communications-related casualties had at least one *Prepare and Send Message* process problem. The second most frequent process area problem was the *Receive and Interpret Message* area. This process area accounted for 16 (21 percent) of the 76 process area problems found. At least one instance of a *Receive and Interpret Message* problem was identified in 37 percent of the 38 communications-related casualties.

The most frequent specific communications problems within the *Prepare and Send Message* and *Receive and Interpret Message* process areas are shown in Table 4 (remember that most casualties had multiple communications problems). The biggest problem by far is *Did not*

Table 4. Percentage of casualties containing selected communications process problems. (N=38 casualties)

Communications Process Area Specific Communications Problems	Frequency
Prepare and send message	**87%**
Did not communicate	68%
Did not request information	29%
Communicated ambiguous, incorrect, or incomplete information	18%
Receive and Interpret Problems	**37%**
Did not monitor communications	13%
Did not interpret information correctly	11%
Did not verify information validity or accuracy	8%

communicate, which contributed to 68 percent of the casualties. A related problem, that of not requesting information, was the second largest problem.

Following are some examples of how these communications problems contributed to casualties. Note that inadequate communication is not the only error which led to the casualty; but if the communication had been adequate, the casualty probably would have been prevented.

- A lighted buoy had been replaced by an unlighted one. The Vessel Traffic Service neglected to inform a vessel of the change (*Did not communicate).* The vessel, which had transited this area often and was navigating by the buoys, hit the unlighted buoy.
- A Tankerman needed to remove the cam lock plug from the end of a diesel hose. He assumed the hose was not pressurized, but did not verify it (*Did not request information*). The hose was, indeed, pressurized, and the plug shot off into the Tankerman's knee.
- While the ship was transiting restricted waters, the Third Engineer noticed that the lube oil pressure was low, and shouted (across a noisy engine room) to a cadet to adjust the pressure. The cadet misunderstood (*Did not interpret information correctly*) and closed the valve, causing the engine to go to dead slow. (Note: the noisy engine room also constitutes a *Transmit Message* process problem.)

3.3 Contributing Factors to Communications-Related Casualties

In determining what caused the communications errors which contributed to a casualty, IOs were asked to choose from a list of 34 individual contributing factors, which were divided into seven areas (see, for example, the bottom of page B-9; the 34 factors do not include "Other"). The seven areas included: Knowledge or Experience in the proper technicques for marine communications (hand signals, standard maritime vocabulary, English skills); Procedures for communications (how to operate a radio); Performance issues regarding not communicating (high workload, forgetting, unwilling to communicate); Assumptions about the situation and one's responsibility to communicate; Environment (noise on the radio channel), Communications Equipment (was it available and in working order); and Management and Government Regulations in terms of whether communications was a "required" part of the job or operating procedure. Each of these areas consisted of several specific contributing factors. An analysis of the types of contributing factors which were found to be prevalent in communications-related vessel and injury casualties is described below.

Frequency of contributing factor areas to communications problems in vessel casualties. Investigating Officers identified 143 individual factors that contributed to specific communications problems among the 29 communications-related critical vessel casualties. Figure 10 presents the frequency with which IOs identified general contributing factor areas across the four communications processes for these critical vessel casualties. As the figure shows, 74 of the total 143 contributing factors identified (52 percent) are associated with the incorrect assumptions held by those communicating. In addition, 112 of the total 143 identified factors (78 percent) are clustered within five of the 28 possible combinations of contributing factor areas and communications processes.

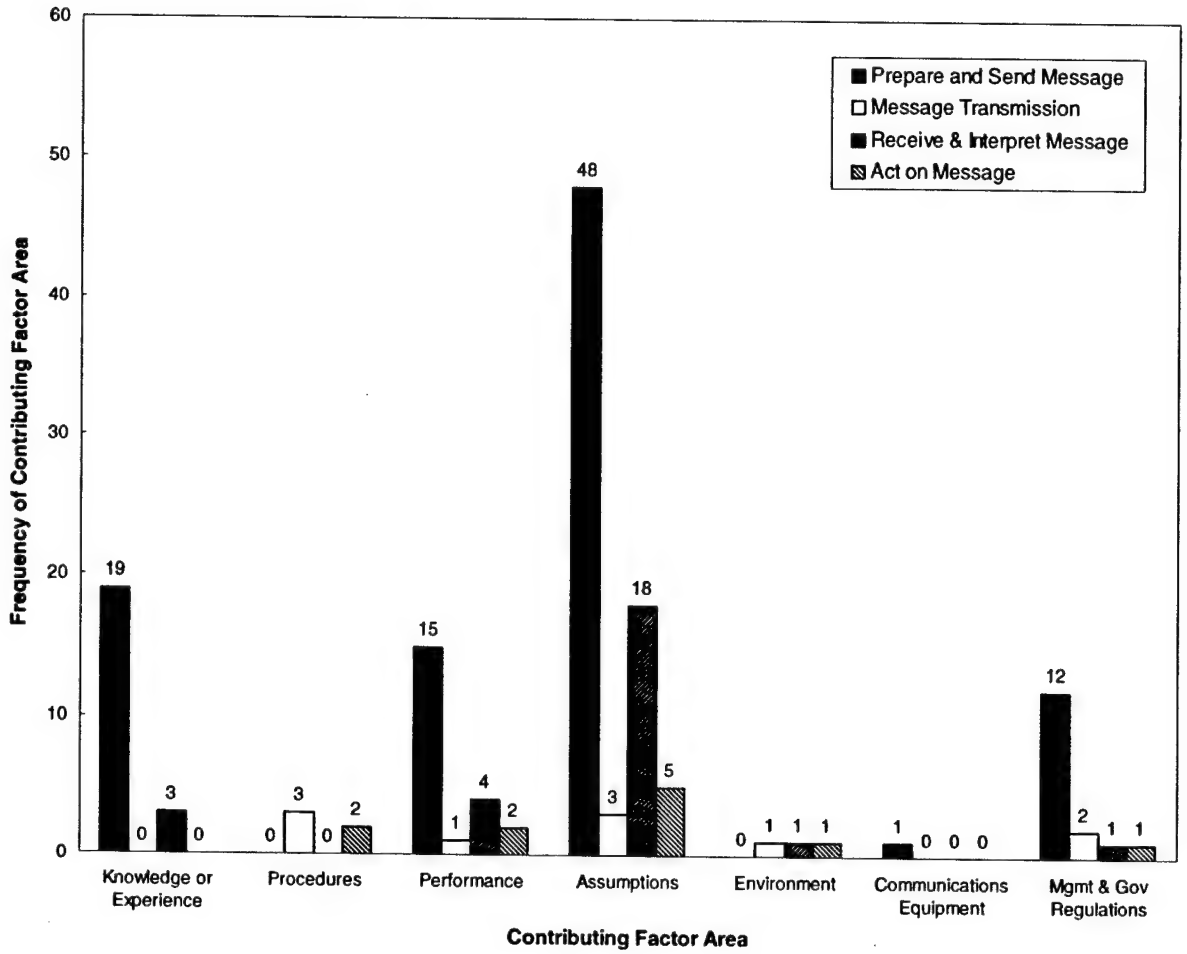

Figure 10. Critical vessel casualties – Frequency of contributing factor areas to communications problems.

Most frequently identified contributing factors to communications problems in vessel casualties. Table 5 lists the 112 specific contributing factors identified in the five most frequently cited factor areas. Review of this table provides a number of insights. First, many of the problems associated with Assumptions in *Prepare and Send Message* stem from the specific contributing factors *Assumed there was no need to communicate* (21 instances) and *Incorrect interpretation of the situation* (10 instances). Second, Performance factors contributing to problems in *Prepare and Send Message* involved both attitude (*Not willing to communicate*) and conflicting job requirements (*Distracted or interrupted by other tasks* and *Individual not at workstation*). Third, a lack of regulation and/or procedures were specific Management and Regulations contributing factors for problems in *Prepare and Send Message.* It should be noted that *Limited English skills* and *Lack of common language* are not as significant as might be thought from Table 5: there were only four casualties in which these problems were found, but multiple individuals contributed to the problem.

Table 5. Critical vessel casualties – Most frequently identified contributing factors within selected communications processes.

Communications Process – Contributing Factor Area Specific Contributing Factor	Frequency
Prepare and send message – Assumptions	**48**
Assumed that there was no need to communicate	21
Incorrect interpretation of the situation	10
Assumed incorrectly that other party knew the information	6
Assumed individual in charge recognized the problem	6
Other	3
Assumed lack of response was silent confirmation	2
Prepare and send message – Knowledge or experience	**19**
Other	6
Limited English skills or knowledge	5
Lack of common language	3
Inadequate knowledge of correct communications protocol	2
Inadequate knowledge of regulatory requirements	1
Improper use of standard marine technical vocabulary	1
Inadequate knowledge of company procedures or policies	1
Receive and interpret message – Assumptions	**18**
Assumed there was no need to communicate	4
Assumed individual in charge recognized the problem	3
Assumed incorrectly that other party knew the information	3
Incorrect interpretation of the situation	3
Other	3
Assumed lack of response was silent confirmation	2
Prepare and send message – Performance	**15**
Not willing to communicate	6
Distracted or interrupted by other tasks	4
Other	2
Not willing to challenge authority	2
Individual not at work station	1
Prepare and send message – Management and regulations	**12**
No regulatory requirement to communicate	7
Inadequate Standard Operating Procedures	4
Other	1

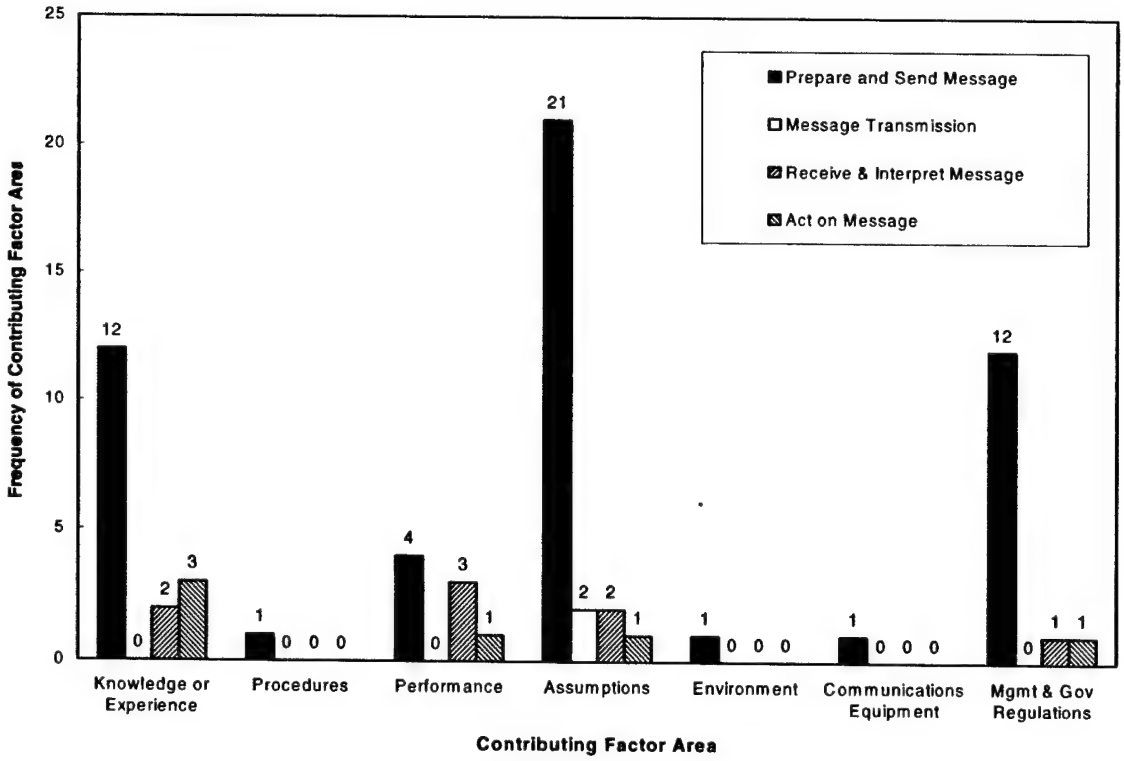

Figure 11. Critical personnel injuries – Frequency of contributing factor areas to communications problems across communications processes.

Frequency of contributing factor areas to communications problems in personnel injuries. Figure 11 presents the frequency with which IOs identified contributing factor areas across the four communications processes for the personnel injury cases. Note that the largest single area (26 of the total 68 contributing factor areas or 38 percent) concerns Assumptions on the part of those communicating. In addition, 45 of the total 68 identified factor areas (66 percent) are clustered within three of the 28 possible combinations of contributing factor areas and communications processes.

Most frequently identified contributing factors to communications problems in personnel injuries. Table 6 lists the specific contributing factors identified in each of the three most frequently cited areas in personnel injuries. Review of Table 6 provides several insights into the factors that contributed to these communications problems. First, *Assumed that there was no need to communicate* is the most prevalent factor contributing to Assumptions in the *Prepare and Send Message* process, and *Incorrect interpretation of the situation* is the second most prevalent in that area. Next, *Lack of common language* is the most frequent contributor to Knowledge or Experience problems in the *Prepare and Send Message* process area (but as mentioned previously, the eight instances of language/English problems occurred in only four casualties). Finally, IOs cited *No regulatory requirement to communicate* as a frequent contributor to Management and Regulation problems associated with the *Prepare and Send Message* process.

Table 6. Critical personnel injuries – Most frequently identified contributing factors within selected communications processes.

Communications Process – Contributing Factor Area Specific Contributing Factor	Frequency
Prepare and send message – Assumptions	**21**
Assumed that there was no need to communicate	13
Incorrect interpretation of the situation	7
Assumed that individual in charge recognized the problem	1
Prepare and send message – Knowledge or experience	**12**
Lack of common language	5
Limited English skills or knowledge	3
Other	3
Inadequate knowledge of regulatory requirements	1
Prepare and send message – Management and regulations	**12**
No regulatory requirement to communicate	7
Not part of individual's job description or responsibilities	3
Inadequate Standard Operating Procedures	2

Table 7. Percentage of casualties with selected, specific contributing factors. (N=38. Note that a given casualty usually has multiple contributing factors.)

Communications Process – Contributing Factor Area Specific Contributing Factor	Frequency
Prepare and send message – Assumptions	
Assumed that there was no need to communicate	50%
Incorrect interpretation of the situation	21%
Assumed other party knew information	8%
Assumed that person in charge (PIC) recognized the problem	5%
Prepare and send message – Management and regulations	
Not required to communicate—no regulation, SOP, or not part of job responsibilities	18%
Prepare and send message – Performance	
Not willing to communicate	16%
Distracted/interrupted by other tasks (high workload)	13%
Prepare and send message – Knowledge or experience	
Inadequate knowledge of procedures/policies	8%
Limited English / no common language	8%
Receive and interpret message – Assumptions	
Assumed there was no need to communicate	13%
Assumed other party / PIC knew information	11%
Incorrect interpretation of the situation	8%

Major communications contributing factors in marine casualties. The types of contributing factors which apply to vessel casualties are almost identical to those which contribute to personnel injuries. By collapsing the data over casualty type, it becomes more apparent what the major contributing factors are to communications-related casualties as a whole. Table 7 shows the major contributing factors in casualties having *Prepare and Send Message* and *Receive and Interpret Message* process problems.

The biggest contributing factor by far is the incorrect assumption that *there was no need to communicate.* Assuming there is no need to communicate often goes hand-in-hand with an *incorrect interpretation of the situation.* Consider the Tankerman example given earlier. The Tankerman had assumed that the hose was not pressurized. If the hose truly wasn't pressurized, then there would be no need to communicate (to ask about the status of the hose). In essence, the Tankerman's incorrect interpretation of the situation led him not to ask for verifying information, and caused him to uncap a pressurized hose and sustain a serious knee injury.

In other instances, failing to communicate appears to be due to not thinking about the "big picture." Here's an example. A barge was moored to a quarry loading facility by a pull cable that was controlled from the facility. A deckhand on the barge notices the pull cable is caught under a deck fitting, so he walks over to free it. Before he gets there, a dock worker starts the winch to take the slack out of the pull cable. The cable tightens, jumps off the fitting, and strikes the deckhand in the arm with such force that the muscles spasm and surgery is required. In this example, neither the deckhand nor the dock worker considered that they were part of a larger team, and that their actions needed to be communicated to, and coordinated with the actions of, other team members. Had the deckhand communicated to the dock worker the status of the pull cable and his intention to fix it, or if the dock worker had communicated to the deckhand his intention to tighten the cable, this accident would have been avoided.

Another *Assumption* that led to a lack of communications was the assumption that someone else recognized the problem and that they would take care of it. As an example, a pilot was docking a ship in rough weather. The Master was on the bridge, too, and noticed that the pier fenders were not positioned correctly for his ship, *but said nothing.* Why? He assumed that the pilot and the dock workers recognized the problem--but they didn't. The pilot lost control of the ship in the high winds, and the ship allided with the pier, sustaining significant damage (due to the mispositioned fenders).

Management and Regulations was the next most frequent contributing factor area to *Prepare and Send Message* errors. This category means that the mariner did not see communication as part of his responsibility: there was no regulation or standard operating procedures (SOP) that required him to communicate, or it wasn't considered part of his job description. This bears some similarity to the assumption that someone else (the person in charge) is responsible for communicating.

The contributing factor, *unwilling to communicate*, deserves a little explanation. In most cases where this was observed, an unlicensed crewmembers was the only person on the bridge when the casualty occurred. It may be that he did not use or respond to the radio for fear of being caught (or getting his captain in trouble).

The primary *Knowledge or Experience* contributing factors to a *Prepare and Send Message* error included mariners who did not have an adequate knowledge of the English language (English is the international standard for ship-to-ship communications), and crewmembers who could not communicate because they lacked a common language. While these two factors appear to represent a moderate-size problem, in fact, only four casualties make up this category: two of these casualties involved both types of contributing factors. While the industry often points to language problems as a serious contributor to casualties, this study (with its small sample size) failed to substantiate that claim.

If we consider *Receive and Interpret Message* process problems, we see some of the same *Assumptions* contributing to these casualties as was seen for *Prepare and Send Message* problems. The primary contributor is *assumed there was no need to communicate.* There were several instances in which no one was on the bridge to monitor communications. The captain left the bridge, believing that there was no other vessel in the area (and thus, no need to communicate). When another vessel eventually hailed his ship, he was not on the bridge to receive the message. A related reason for not monitoring communications was the belief that someone else was responsible for that. *Incorrect interpretation of the situation* caused *Receive and Interpret Message* errors and led to a few casualties. In a tragic example (in which there were several different communications errors), a roustabout was fatally pinned and crushed by a barge while attempting to tie off a mooring line. He was so focused on tying the line (cognitive tunnel vision) that he did not respond appropriately to the yelled warning from the deckhand on the barge. He apparently heard the deckhand, because he looked up briefly, but he neither communicated with the deckhand nor looked around to assess what had become a dangerous situation.

Why do mariners choose <u>not</u> to communicate? Two-thirds (68%) of these casualty cases involved someone who had information to communicate but *chose not to communicate.* In almost all (92%) of these "did not communicate" casualties, it appears that a mariner did not perceive that there was a threat. In some cases, an incorrect interpretation of the situation led to this belief: the mariner was unaware that a problem was unfolding, and thus, did not communicate information that could have helped avoid a casualty (like the Tankerman example). In other cases, the mariner was looking only at his small role in a larger, team-oriented task, and did not appear to realize that his actions (or inactions) could have a deleterious effect on another person (e.g., the barge pull cable). But in almost half (42%) of these "did not communicate" casualties, there was a second person on the scene who *did* perceive the threat, but still *did not communicate.* In these situations, the mariner appeared to believe that others saw the threat and would do something about it (e.g., the Master who watched his ship allide with the pier), or, similarly, that it wasn't his job responsibility to say anything. The first problem, that of not perceiving a threat, may be difficult to solve. It appears to get to the very crux of how people interpret bits of information and build a "mental model" of their situation (situation awareness). However, the second problem, that of perceiving a threat but deciding not to do anything about it, should be much easier to fix. This is the type of situation that "crew resource management" (originally developed as cockpit resource management in aviation) was designed to prevent. Mariners need to be trained to think of themselves as vital and participating parts of a team, and to feel empowered to speak up when a threat is recognized. This fairly simple intervention could have prevented 29% of the communications-related casualties in this study.

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4 CONCLUSIONS

The present study was conducted to facilitate the investigation and reporting of communications contributions to marine casualties. This study had two objectives:

- Develop a method for the focused investigation and reporting of communications problems.
- Identify the characteristics and underlying causes of the communications problems that lead to marine casualties.

The communications process model appears to be an effective tool for identifying specific communications errors and for determining the factors that contribute to those errors. The communications process model consists of four communications processes: *Prepare and Send Message, Message Transmission, Receive and Interpret Message,* and *Act on Message.* Investigating Officers were easily able to determine in which process area an error had occurred, and to identify specific communications problems. The model further incorporates seven contributing factor areas and 34 specific contributing factors, allowing IOs to provide structured and informative data on the causes of communications-related casualties.

The communications process model was successfully applied to 38 communications-related marine casualties. Some specific conclusions are given below.

4.1 Communications Investigation and Reporting Procedures

We developed the communications process model and implemented a logical and direct procedure for screening casualties to identify potential communications contributions. The procedure consisted of an initial screening for direct human factors contribution, followed by five questions regarding the potential need for communications during operations leading up to a casualty. Use of this procedure resulted in the selection of 50 cases from a set of 200 critical marine casualties. The screening procedure was so effective that of these 50 cases, 38 (76 percent) were subsequently judged by IOs to have a communications problem. We conclude that the set of screening questions used in this study are a useful tool in identifying cases where there is a high likelihood that a communication problem contributed to the casualty. Further, the follow-up questions allowed the IOs to identify specific communications process problems and their apparent causes. Such data will allow the CG to determine how to target future educational and regulatory initiatives in order to prevent similar marine casualties.

Feedback from IOs indicated that the procedures were valuable and increased the time spent on each case by only approximately 35 minutes. We have revised and streamlined the procedures somewhat, and feel they are ready to be deployed by all the MSOs. The revised procedures are included as Appendix D.

Our analysis of the communications data provided a number of insights into the nature and underlying causes of communications problems that contribute to marine casualties, demonstrating the value of the method. In the present study, communications were cited as contributing to 18 percent of all critical vessel casualties, 28 percent of critical personnel

injuries, and 19 percent of all 200 critical casualties. These levels are sufficiently high to warrant further attention.

4.2 Characteristics and Underlying Causes of Communications Problems

Our analysis of the nature and causes of the communications problems in the 38 communications-related casualties provided valuable insights into the investigated casualties. The results provided specific findings that could serve as a point of reference for future comparisons and ameliorative actions. The primary process problems occurred in the *Prepare and Send Message* process, and were found in 87% of these casualties. They were primarily caused by flawed assumptions, in particular the assumption that there is no need to communicate or by an incorrect interpretation of the situation. The second most common set of process problems occurred in the *Receive and Interpret Message* process. These errors were also predicated on flawed assumptions, particularly the belief that there is no need to communicate or that another person is responsible for communications.

The single largest communications problem (found in 68% of the casualties) involved mariners who did not initiate communications when it would have been appropriate. There were two different types of causes for not communicating. In almost every casualty where this occurred, at least one mariner did not appear to perceive that a dangerous situation was developing, and thus, did not communicate information because he did not realize the need. This problem conveys the need to improve mariner situation awareness, both as it applies to his own tasks and as it applies to the larger team of which he is a part. The second reason that some mariners did not communicate is that, while they were aware that a dangerous situation was unfolding, they incorrectly assumed that others also saw the danger and would take action. This is the type of situation that "crew resource management" was designed to prevent. Based on this study, training crewmembers to speak up when a threat is noticed would be predicted to prevent 29% of communications-related casualties. As a first step in making the industry aware of these problems, the results of this study were presented at the Maritime Human Factors Conference in March, 2000.

5 REFERENCES

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Appendix A

Training Materials

This appendix provides most of the 93 slides presented in the one-day Investigating Officer training conducted at participating Marine Safety Offices. The slides showing completed forms are omitted.

APPENDICES A-D ARE PROVIDED IN SEPARATE FILES.

Communications in Casualty Investigations

Investigation and Reporting Procedures

Marine Safety Offices
August 1997

Project Team

U.S. Coast Guard R & D

- Myriam Smith, Human Factors Research Scientist
- Anita Rothblum, Human Factors Research Scientist

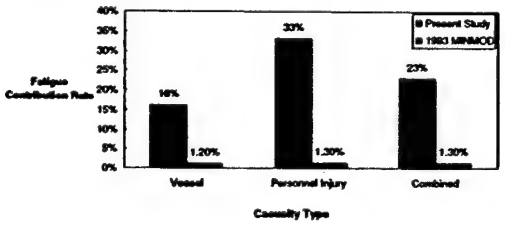
Battelle

- Marvin McCallum, Senior Research Scientist
- Mireille Raby, Research Scientist

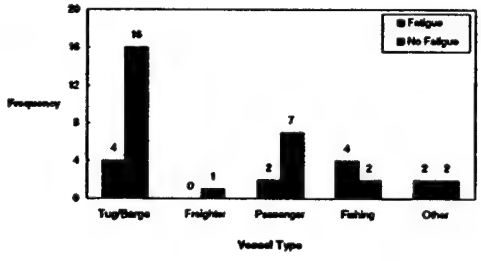
Project Background

- USCG has great potential for determining human factors role in casualties
- USCG R&D fatigue investigation project (pilot study - 1996)

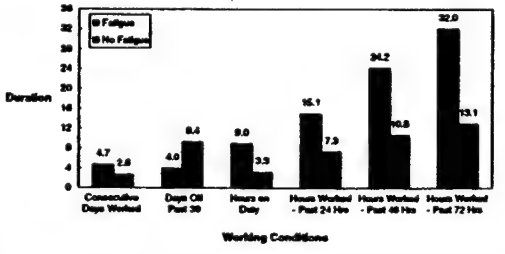
Fatigue Study Results: Level of Fatigue Contribution



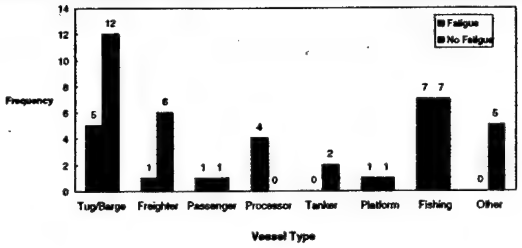
Fatigue Study Results: Vessel Casualty Industry Segments



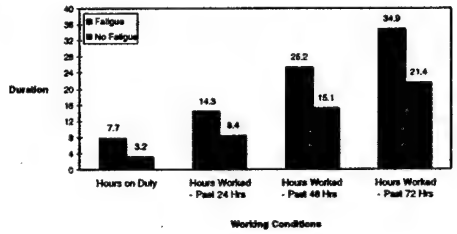
Fatigue Study Results: Vessel Casualty Working Conditions



Fatigue Study Result: Personnel Injury Industry Segments



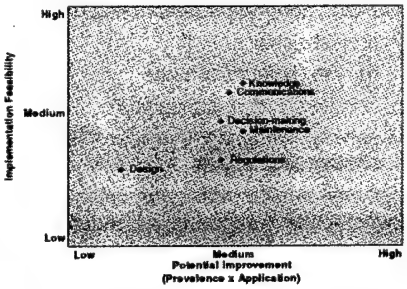
Fatigue Study Results: Personnel Injury Working Conditions



Program Objectives

1. Enhance investigation of human factors in marine casualties.
2. Develop and implement single human factor topic investigation and reporting procedures.
3. Evaluate procedures usability, value of data, and applicability of methods.
4. Support *Prevention Through People.*

Result of Human Factors Topic Assessment



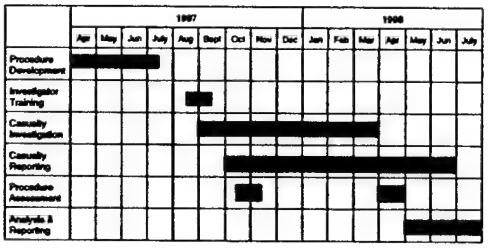
Communications Investigation Goals

- Determine extent of communications contribution to marine casualties.
- Identify trends in role of communications breakdowns in maritime industry.
- Increase maritime safety by identifying operational practices that contribute to communications breakdowns and casualties.

Project Plan

1. Develop investigation procedures and forms.
2. Train Investigators at selected MSOs.
3. Assess and modify procedures.
4. Continue investigation for 6-8 months.
5. Obtain final MSO feedback.
6. Analyze data and report findings.

Project Overview



Today's Training Schedule

- Morning
  - Project background & training objectives
  - Human factors & human error concepts
  - Communications concepts
  - Investigation & reporting procedures
- Afternoon
  - Case scenarios
  - Wrap-up

Training Objectives

1. Develop general understanding of:
   - project goals
   - human factors concepts
   - human errors in casualties
   - communications process problems & contributing factors
2. Become familiar with communications investigation & reporting procedures

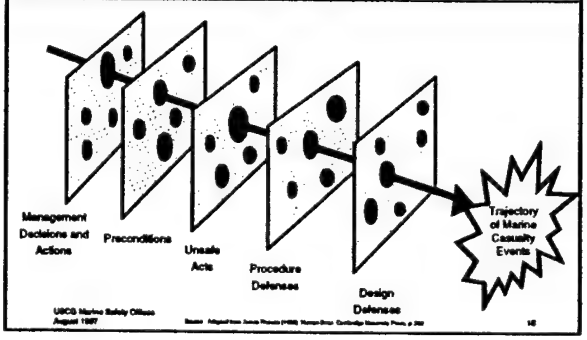
What is Human Factors?

Multi-disciplinary approach to the study of human abilities and limitations and how characteristics of *machines* and of the *environment* (physical, organizational) interact to affect *human* performance.

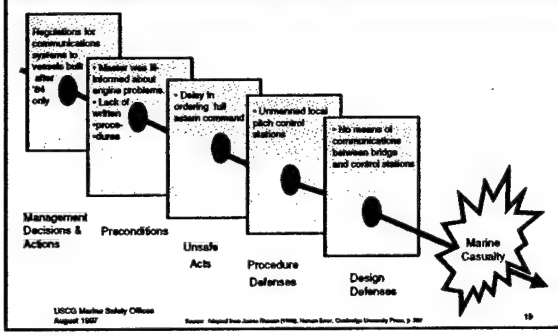
Human Factors Perspective to Casualty Investigation

- Human capabilities & limitations?
- Human performance in operating & maintaining equipment or system?
- Operating conditions under which humans act?
- Environmental conditions in which humans operate?

Factors Contributing to Marine Casualties



Accident Causation Model Communications Example



Unsafe Acts - Unsafe Conditions

Unsafe Acts

- acting without proper authority
- failure to warn or secure
- operating at improper speed
- using defective equipment
- using equipment improperly
- failure to use personal protective equipment
- improper loading or lifting

Unsafe Conditions

- inadequate guards or protection
- defective tools, equipment, substances
- congestion
- inadequate warning system
- fire and explosion hazards
- excessive noise
- inadequate illumination

Unsafe Actions & Errors

- In hindsight a human action/inaction is labeled an error.
- Errors are unplanned, unintentional, and represent inappropriate actions in a given set of circumstances.
- Contributing factors to errors and consequences of errors are the important factors to study.
- Only errors which have the greatest potential for reducing safety & system effectiveness, and factors contributing to these errors, should be investigated.

Human Error Classifications

Commission Errors inappropriate action e.g., while fighting fire, crewmember turns the fuel pump to 'on' rather than 'off'	**Omission Errors** absence of a required action e.g., while fighting fire, crewmember forgets to mention that fuel pump is 'on'
Slip correct intention, but inappropriate action e.g.,switched radar 'off' rather than 'on'	**Mistake** inappropriate intention e.g., maintained full speed in narrow channel despite traffic

Error Remediation

Human errors can be reduced by addressing:

1. Task design_____lower mistakes
2. Equipment design_____lower slips
3. Training _____lower slips &/or mistakes
4. Assists & Rules_____lower mode violations
5. Error-tolerant systems_attempts to avoid irreversible actions

Why Communications?

- One of 10 critical human factors contributions to marine casualties identified by *Prevention Through People QAT.*
- Ranked 2nd priority in assessment of potential investigation topics.
- Lack of reliable data; estimates of contribution range from 15-40%.

Prevalence of Communications Factors in Maritime Casualties

- NTSB: 'Inadequate communication/coordination' was identified as contributing to 44 of 215 (20.5%) casualties
- Between 1981 and 1992, the TSB investigated 273 occurrences involving vessels in Canadian Pilotage waters, under the conduct of a pilot. Of these, 200 had human factors as the most significant contributing factor:
  - **10% due to lack of communication**
  - **8.5% due to misunderstanding**
  - 45.5% misjudgment of pilot or master
  - 23.5% inattention of pilot or OOW
  - 12.5% other human factors.

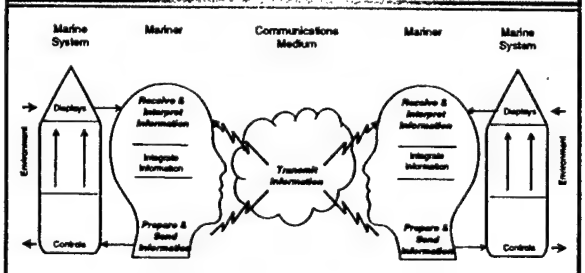
What Do We Mean by Communications?

- Process by which information is exchanged between individuals through a common system of symbols, signs, or behavior.
- A system (e.g., telephones, walkie-talkies, PA system) for communicating
- Written communications (e.g., standing orders, notes, faxes)

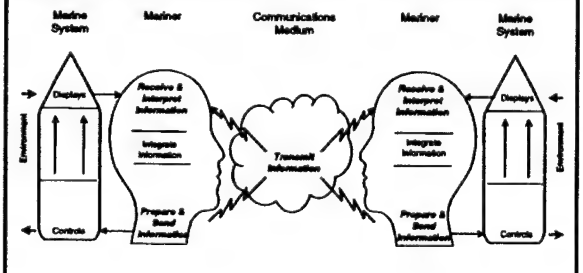
Basic Facts about Safety Communications

- "A communication requires feedback.
- Communications are not all good, even when they are well-intentioned.
- Communications may not be well presented.
- Communications tend to be distorted in proportion to the number of channels they must past through.
- The greater the number of communication channels being used at any one time, the greater the probability of a communications breakdown.
- Noise level impairs communications."

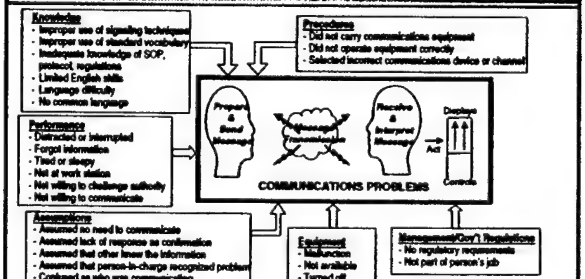
Marine Communications Model



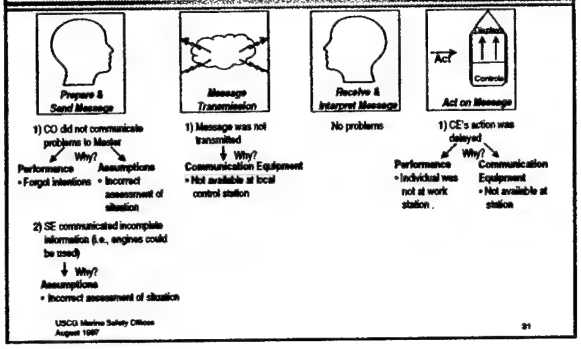
Marine Communications Model



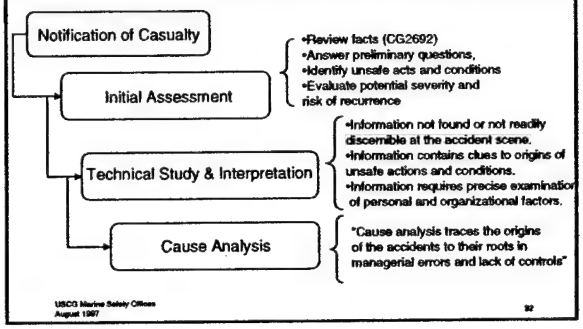
Contributing Factors to Communications Problems



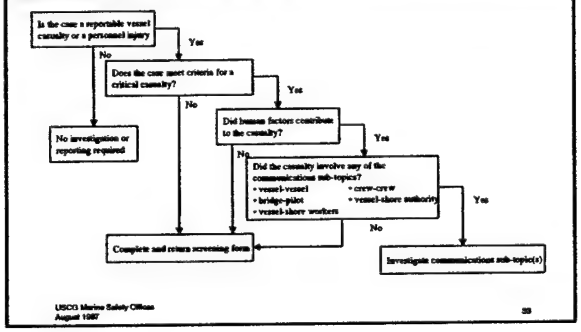
Communications Concepts Applied to a Casualty Case



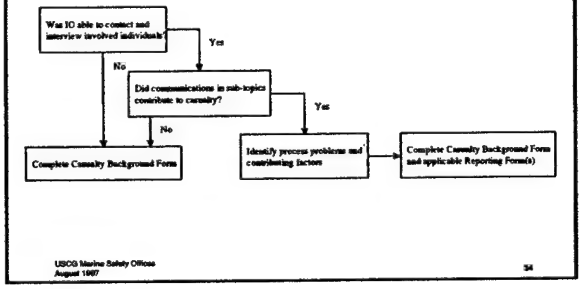
General Investigation Process



Overview of Communications Investigation and Reporting Process



Overview of Communications Subtopic Investigation & Reporting



Investigation and Reporting Forms

1. ***Casualty Screening*** **Form**
   - » Criticality of Casualty
   - » Human factors involvement
   - » Communications Sub-topic
2. ***Casualty Background*** **Form**
   - » Reference information
   - » Basic casualty information
   - » Individuals involved

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Investigation & Reporting Forms, cont.

3. ***Communications Reporting*** **Forms**
   - » Set of <u>five</u> sub-topic forms
     - Vessel - Vessel
     - Bridge - Pilot
     - Crew - Crew
     - Vessel - Shore Authority
     - Vessel - Shore Workers
   - » Content
     - Reference information
     - Individuals contacted
     - Specific communications contribution
     - Communications analysis
     - Conclusions and comments

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Casualty Screening Form

Insert blank form

Casualty Background Form

Insert blank form

Communications Reporting Forms

Insert blank forms

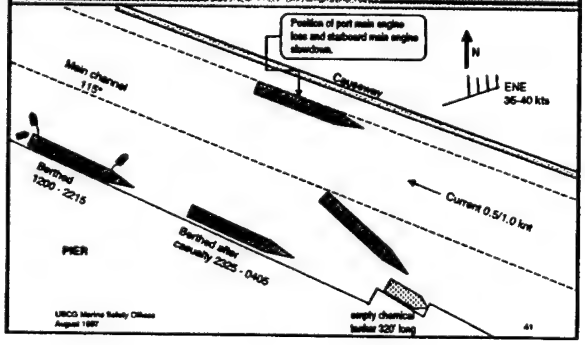
CASE 1 — Engine Failure on board a Cruise Ship

Summary:

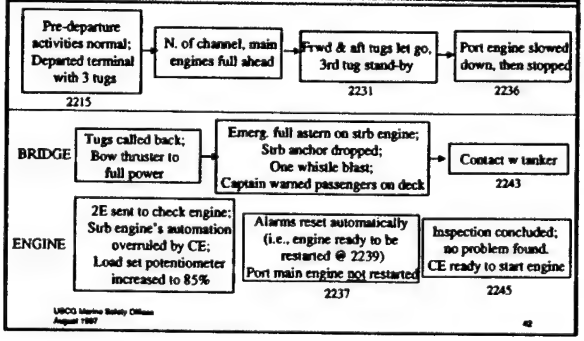
Shortly after departing port at 2242, the *MS Funship*'s port main engine stopped. While maneuvering against the wind (ENE 35-40 knots), with the assistance of 3 tug boats, contact was made with a moored empty chemical tanker.

» Limited damage, no deaths or injuries, no pollution.

CASE 1 — Sketch of the Area



CASE 1 — Factual Events



CASE 1 — Communications

Communicated

Bridge - 3O reported slowdown of port engine to captain and CO.
- Captain asked pilot to recall tugs. Pilot ordered tugs to position on port side and one on stbd side.
- Captain ordered emergency full astern and anchor to be dropped. CO double rang engine order telegraph while 3O called ECR.
- Captain ordered a whistle blast to warn tanker & shouted from wing to warn passengers of immediate danger.

Engine - CE told 3O to be careful to not overspeed stbd engine.
- CE told 2E to check port main engine; 2E came back & indicated there appeared to be no problem.
- CE told 2E to inspect thrust bearing.
- CE pressed call button for additional assistance.
- 2E told CE that visual inspection was completed & no problems.

CASE 1 — Communications, cont.

Not Communicated

Bridge - Captain did not call CE to tell him that he needed the port engine back a.s.a.p.
- Captain believed CE knew this was an emergency.
- Captain believed that due to vessel's recent history of loss of propulsion, that CE understood that when an engine was lost while in restricted waters it was to be given back a.s.a.p.
- Captain did not want to interrupt CE who was busy.

Engine - CE did not call captain to tell him that the port engine could be used after all the alarms had reset.
- CE did not tell captain that he chose not to start port main engine until the thrust bearing was visually examined.

CASE 1 — Forms to Complete?

Casualty Screening Form --> Yes

Casualty Background Form --> Yes

Casualty Reporting Forms
- vessel-vessel --> Yes
- bridge-pilot --> Yes
- crew-crew --> Yes
- vessel-shore authority --> No
- vessel-shore workers --> No

CASE 1 — Screening Form

Insert completed form

CASE 1 — Casualty Background

Insert completed form

CASE 1 — Vessel-Vessel Form, Side 1 only

Insert completed form, Side 1 and leave notes here

- This is the first of the *Communications Reporting Forms* that has to be completed, as identified in Section 3 of the *Casualty Screening Form*.
- Section 1, is for the most part, similar to the previous ones. Again, you'll write your name, MSO and case number. The difference is that we ask you for some quality control data. We need to have the date that this form was completed. We also need you to indicate how much time was spent investigating communications-related factors only. Not the entire time you spent investigating this casualty, but rather the additional time you had to spend to collect the communications-related information, that you might not have done if you were not participating in this project. In item #6 you indicate how much time was spent completing all of these forms.
- Section 2 is very similar to Section 3 of the *Casualty Background Form*. In this section we ask that you identify the individuals you called or talked to in order to investigate the communications-related information. For each individual contacted, we ask that you indicate: 1) their name, 2) the number of calls made, and 3) to the best of your capabilities, the individual's fluency in the English language. We have provided some definitions in the instructions of what the 4 categories are. Let us review them. (Read instructions).
- Section 3 is the beginning of the communications-related reporting process. In this section, we ask that you look at the vessel-vessel communications only, that is were communications between the two vessels required or advisable, and if so, how were they conducted and were they a contributing factor to this casualty. What you answer in this section 3 will influence whether you complete section 5 or not. Let us review each item. Item #16 requires that you indicate whether communications between vessels were advisable. In this casualty they were in order to inform the tanker crew of the imminent danger. So, we checked 'yes' and wrote the purpose. Item #17 asks that you describe how these vessel-vessel communications were done. For each one of the 5 items listed vertically to the left you check the appropriate box, of the 4 options. For example, in this casualty, with regards to the vessel-vessel communications, did the vessels communicate using a VHF radio system? No, it was not used and it was not necessary.

CASE 1: Bridge-Pilot Form, Side 1 only

Insert completed form, side 1

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CASE 1: Bridge-Pilot Form, Side 1 only

Insert completed form, side 1

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CASE 1: Crew-Crew Form, Side 2

Insert completed form, Side 2

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CASE 2 — Queen Elizabeth II

Summary:

On August 7th 1992, the passenger vessel *RMS Queen Elizabeth II* was outbound in Vineyard Sound, Massachusetts, when the vessel grounded on a rocky shoal about 2.5 miles South of Cuttyhunk Island.

- Weather was clear, visibility 10-15 miles, waterway calm with light winds
- All propulsion, steering, and navigation equipment was functioning properly
- $13.2 million in damage, no deaths or injuries, no pollution

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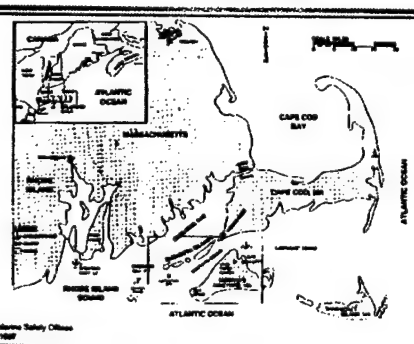
CASE 2 — Sketch of the Area, Accident Site



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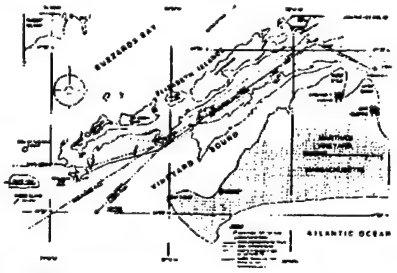
CASE 2 — Sketch of the Area, Vessel's Track



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Case 2 —Event Timeline

Ship	2050 Lift anchor	2115 Round West Chop		2144 Pass NA buoy on heading of 235°	2150 Vessel steady on course of 250°		2158 Vessel aground
Pilot	2052 Set speed to 15 knots	2115 Increase speed to 18 knots	2124 Increase speed to 24 knots	2144 Change course from 235° to 250°		2154 Course changed to 240°	
Master	2050 Turn vessel to proper heading and give conn to pilot					2154 Requests (through FO) to pass further south of Sow & Pigs Reef	

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CASE 2 — Communications Investigation - Pilot

Generic
- navigated this vessel before?
- navigated with this bridge crew or Master before?
- aware of master's intentions regarding the voyage?
- discussed his own passage planning intentions?
- aware of other crewmembers' actions?
- was a pilot card handed? was it necessary and adequate?

Casualty Specific
- did the pilot consult with the master regarding the ship's course for the outbound passage?
- did pilot and master discuss and approve changes in speed?
- did the pilot consult the ship's charts?
- did pilot discuss course changes with master?
- did pilot discuss disembarkation point?

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CASE 2 — Communications Investigation - Bridge Crew

Master
- navigated with this pilot before?
- always aware of pilot intentions and actions?
- discussed his passage planning intentions?

Bridge crew
- language difficulties between crewmembers and pilot?
- did pilot interact with crewmembers other than the Master (e.g., give orders to helmsman and/or officers)?
- were crewmembers aware of pilot's intentions?
- did they voice any disagreement or concerns to the pilot or other crewmembers?

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CASE 2 — Communications Investigation Topics

Generic
1) master pilot relationship
2) master's and pilot's pre-sailing conference
3) their manner & content of communications
4) their interaction with each other and with the bridge crew

Specific
1) the choice of tracklines, including courses and speed selected
2) the effects of decisions made by the pilot and the master about the ship's course
3) the master's and pilot's assumptions about the outbound track
4) the master's and pilot's knowledge of the extent of squat at high speeds

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CASE 2 — Findings

Communicated

Master
- asked the pilot about speed restrictions
- asked the pilot if he objected to a speed increase to 24 knots

Pilot
- agreed to the speed increase

Officers
- 2ndO told 1stO who told Master of difference between actual ship's course and intended one
- 1stO told pilot of Master's request for a course change

Helmsman
- no language difficulties
- took orders directly from the pilot

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CASE 2 — Findings, cont.

Not Communicated

Master
- did not discuss or verify his choice of courses for the passage with the pilot
- not aware of pilot's plan to alter course at the 'NA' buoy
- (indirect communication): asked the 1stO to tell the pilot to change course, rather than telling the pilot himself

Pilot
- did not verify Master's voyage plan or navigator's charts
- did not inform Master or crew of intention to alter course twice to his intended disembarkation point
- did not discuss the course change with Master prior to changing course as requested by Master
- did not tell the Master about the 39' sounding area

Officers
- 2ndO did not tell anyone that ship's new course was passing over 39' sounding area

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CASE 2 — Forms to Complete?

Casualty Screening Form --> Yes
Casualty Background Form --> Yes
Casualty Reporting Form
- vessel-vessel --> No
- bridge-pilot --> Yes
- crew-crew --> Yes
- vessel-shore authority --> No
- vessel-shore workers --> No

CASE 2 — Screening Form

Insert completed form

CASE 2 — Casualty Background

Insert completed form

CASE 2 : Bridge-Pilot Form, side 1

Insert completed form, side 1

CASE 2: Bridge-Pilot Form, side 2

Insert completed form, side 2

CASE 2: Crew-Crew Form, side 1

Insert completed form, side 1

CASE 2: Crew-Crew Form, side 2

Insert completed form, side 2

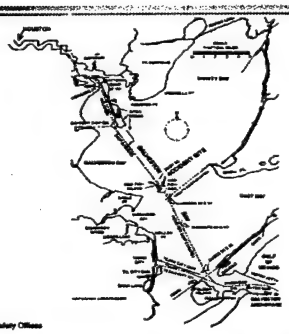
CASE 3 — Collision between Shinoussa & Chandy N

Summary:

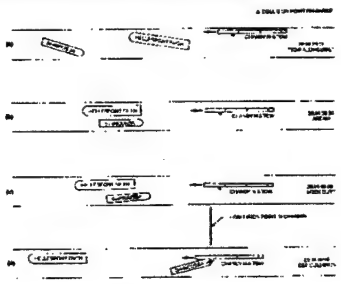
On July 28th1990, at approximately 1440, the Greek tankship *Shinoussa* collided with a 3-tank barge tow being pushed by the US towboat *Chandy N* in the Houston Ship Channel in Galveston Bay, Texas.

- Partly cloudy and visibility of 6 miles in light haze. Light winds and current at less than 1/3 knot.
- All propulsion, steering, and navigation equipment was functioning properly.
- $1.7 million in damage, $2.1 million in oil spill cleanup, no deaths or injuries.

CASE 3 — Sketch of the Area, Accident Site



CASE 3 — Sequence of Events



CASE 3 — Investigation Planning

1. Review known facts
2. Determine what information is needed to find what happened & why
3. Assess if 'communications' could be an issue
4. Draft questions to pinpoint communications issues (if applicable)
5. Interview all individuals involved (at least once)
6. Review factual information & evidences
7. Complete investigation reporting forms
8. Send completed forms to Battelle

CASE 3 — Interview Guidelines

- Who?
  - People directly involved in the casualty
  - People who may know while not being involved directly (e.g., safety officer)
- When?
  - As soon as possible after the casualty, on site preferably
- Why?
  - To obtain information that is not available on CG2692
  - To verify facts & get detailed account of events
  - To review individuals' actions or inactions
  - To identify communication problems (if any) & contributing factors

CASE 3 — Potential Persons of Interest

- This Casualty:
  - *Shinoussa's* Captain & Pilot
  - *Chandy N's* Operator
  - *Hellsport Faith's* Pilot
- In general, consider:
  - Individual listed in CG-2692's "Description of Casualty"
  - Individual who was injured
  - Individual supervising the injured person
  - Individual in charge of vessel activities
  - Witnesses or co-workers
  - Individual who committed the last action/decision prior to the casualty

CASE 3 — Communications Interview Topics

1. Determine who you will talk to and why
2. Ask them to relate WHAT happened
3. Determine:
   - individual's activities at time of casualty
   - individual's frame of reference at time of casualty
   - individual's decisions/actions/inactions at time of cas.
   - individual's interactions with others (who, what, when, how, why)
   - conditions under which the individual was operating

CASE 3 — Communications Interview Topics, cont.

- Determine if communications were advisable
  - What was the situation?
  - Was the individual interacting with someone else? Should have individuals been communicating?
- Determine if there was a communications breakdown
  - Did a communication take place?
  - How was the information communicated?
  - What information was communicated?
  - When did communications take place?
  - What means of communications was used?
  - Were there any difficulties in transmitting the information?
  - Was the communication interrupted?
  - Was the information well-received, interpreted, and acted upon?

CASE 3 — Communications Interview Topics, cont.

- Identify contributors to communications breakdowns
  - Language difficulty?
  - Problems with the communications equipment (e.g., malfunction, not available, turned off)?
  - Communication affected by environmental factors (e.g., ambient noise, signal disruption, traffic)?
  - Individual's procedures or actions undermine the communications (e.g., didn't have his radio, selected wrong channel)?
  - Individual's mental model of the situation incorrect (i.e., individual made incorrect assumptions)?
  - Individual's own job performance affected by various factors (e.g., tired, interrupted by other tasks)?

CASE 3 — Communications Interview Topics, cont.

- Conclude by asking the individual:
  - *What* contributed to the casualty and *Why*
  - Was communications a contributing factor
  - *How* communications was a factor
  - Any safety recommendations to prevent similar occurrence

CASE 3 — Role Playing

Instructors role play the interview or ask IOs what questions they would ask the *Shinoussa's* pilot.

CASE 3 — Summary of Findings

- *Shinoussa*
  - Pilot's first time on board.
  - Master & pilot did not have a formal exchange before sailing.
  - No language difficulties between pilot and watch crew.
  - Pilot failed to report to 2 of 3 VTS reporting points.
  - Master & 2ndO questioned pilot about need for full speed.
  - Prior to collision, pilot was on the radio with *Chandy N.*
  - Last command prior to communication was 'Port 15'.
  - After radio communications, pilot ordered 'hard to starboard'.
  - Master & 2ndO recalled order but not hand signals.
  - Pilot informed *Chandy N* that there was nothing he could do.

CASE 3 — Summary of Findings, cont.

- *Chandy N*
  - Operator reported to VTS as required.
- *Hellespont Faith*
  - Pilot had sailed on board this vessel numerous times.
  - Pilot and Master had a formal exchange of information.
  - Pilot reported to VTS as required, but did not mention speed.
  - No language difficulties between pilot and watch crew.
  - Pilot contacted the *Chandy N* on Ch.13 to arrange overtaking & to thank him after overtaking.
  - Pilot contacted *Shinoussa's* pilot to inform him of overtaking but did not discuss a specific agreement to carry out meeting.
  - Pilot failed to ask the *Shinoussa's* pilot for a speed reduction.

CASE 3 — Forms to Complete?

Casualty Screening Form --> Yes
Casualty Background Form --> Yes
Casualty Reporting Form
- vessel-vessel --> Yes
- bridge-pilot --> Yes
- crew-crew --> No
- vessel-shore authority --> Yes
- vessel-shore workers --> No

CASE 3 — Screening Form

Include completed screening form

CASE 3 — Casualty Background

Include completed Background form

CASE 3: Vessel-Vessel Form, Side 1

Insert completed form (side 1 only)

CASE 3: Vessel-Vessel Form, Side 2

Insert completed form (side 2)

CASE 3: Bridge-Pilot Form, Side 1

Insert completed form (side 1 only)

CASE 3: Bridge-Pilot Form, Side 2

Insert completed form (side 2)

CASE 3: Bridge-Pilot Form, Side 2

Insert completed form (side 2)

Next 10 Months

• MSO training	August - Sept '97
• Investigating & reporting	Sept '97 - Mar '98
• Initial assessment	Oct-Nov '97
• Wrap-up reporting	June '98
• Final assessment & preliminary findings	April '98

Your Role in the Next Month

1. Conduct communications investigation for vessel & personnel injuries (no pollution)
2. Contact Battelle with inputs regarding:
   - data collection forms (format, questions)
   - investigation and reporting procedures

Project Schedule

1. One month assessment:
   - Maintain contact with IOs
   - Identify need to modify forms & procedures
2. Approximately 6-month data collection
3. Final evaluation of procedures
4. Research team provides feedback

Reporting Package

- Each casualty reporting package should contain:
  - *Casualty Screening* Form
  - *Casualty Background* Form
  - *Communications Reporting* Form(s)
  - CG.2692
  - MCIR & MCNS
- Collect all casualty reporting packages and send once a week

How to Contact Us

- By phone/fax
  - Marvin McCallum 206-528-3242
  - Mireille Raby 206-528-3234
  - fax 206-528-3552
- By mail

  Battelle, HFTC
  4000 NE 41st Street
  Seattle, WA, 98105-5428
- By e:mail

  mccallum@battelle.org
  raby@battelle.org

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APPENDIX B

Procedure Assessment

This appendix summarizes the results of the assessment questionnaire that was administered at the end of the data collection period to all available participating Investigating Officers. A copy of the questionnaire follows the discussion of the assessment results.

Value of Training

Using a scale of 1 (poor) to 5 (excellent), Investigating Officers were asked to rate the project training on four factors: (1) explaining the purpose of the forms; (2) describing what information to collect; (3) describing how to complete the forms; and (4) preparing IOs for this additional role. Of the 14 IOs surveyed, 10 indicated they had taken part in the initial full-day training session. Average ratings for each of the four factors ranged between 3.7 and 4.1, suggesting that the initial training was fairly useful to all of those who received it. Among those who could not attend the initial full-day training session, four IOs indicated they received some form of training from their colleagues at their MSO. Their average ratings for that training, using the same four factors as above, were slightly lower, ranging between 3.5 and 4.0. Thus, it appears that the initial full-day training adequately prepared IOs for their responsibilities in this study, including the training of other IOs who were unable to attend the initial training.

Usability of the Investigation and Reporting Procedures

The usability of material supporting the investigation and reporting procedures was assessed for: (1) the *Instructions for Completing and Sending of All Forms;* (2) the *Screening and Background Form;* and (3) the *Communications Reporting Forms.* Although all respondents received a copy of the instructions, IOs did not typically consult it on a regular basis during either the investigation or reporting of a casualty. Seventy-one percent of the IOs reported referring to the instructions less than half of the time during an investigation, and 64 percent reported referring to them less than half of the time while completing the forms. When asked to rate the instructions on their ease of use and value in the investigating and reporting process on a scale of 1 (poor) to 5 (excellent), IOs gave them moderate ratings, with average ratings ranging between 3.0 and 3.6. Each of the forms was also rated on its ease of use and value, using the same five-point scale. Both forms received moderate ratings, with averages ranging between 3.3 and 3.5.

When asked to judge the two-step investigation approach (i.e., first determining whether a case was a critical human factors case with potential for communications contribution, then collecting communications information), 11 of the 14 IOs rated it as Useful, Very Useful, or Extremely Useful. When rating the benefit of these procedures and forms to the investigation and reporting of human factors and communications-related information, IOs gave the procedures an average rating of 3.3 on a scale of 1 (poor) to 5 (excellent). Suggestions for improving the investigation and reporting process included streamlining the screening process, extending the data collection period to allow more time to process case forms, and providing in-person supervision by human factors experts during investigations.

Ability to Collect Valid Communications Information

Investigating Officers were asked to rate the validity and accuracy of the information they received pertaining to the contribution of communications to the casualties they investigated. These ratings were provided for 102 cases in which communications was investigated. Among these cases, average ratings were 3.9 on a scale of 1 (not at all true and accurate) to 5 (extremely true and accurate). On average, IOs judged the information upon which their reports were based to be moderately valid and accurate.

Value of Feedback to Marine Safety Offices

Marine Safety Officers received feedback on their performance during the study in three different ways: (1) on-site visits and presentations, (2) the *Marine Investigator* newsletter, and (3) a summary sheet of comments and questions on casualty cases. On-site briefings were always well attended, involving lively discussions of investigation and reporting pitfalls and strategies for success. All assessment survey respondents indicated having received a copy of the newsletter. On a scale of 1 (poor) to 5 (excellent), ratings of the newsletter ranged from 3.3 to 4.0, indicating that the IOs found the newsletter useful for keeping current with the status of the study, summarizing the latest procedures to use, and answering specific concerns and questions. Overall, we believe the feedback mechanisms employed in the present study were successful in establishing and maintaining IO involvement. Further, it is our view that the key to the success of the feedback to the MSOs was that it provided ongoing evidence that the IOs were directly contributing to the meaningful analysis of marine casualties.

Perceived Benefits of Study

One of the questions on the final survey addressed the potential benefits of this study to the IO and the USCG. With respect to benefits to the individual IOs, most respondents said the study gave them a heightened awareness of the potential contribution of communications to casualties. Several IOs also said the experience of participating in the study would prompt them to investigate communications more thoroughly in the future. With respect to benefits to the USCG, IOs mentioned that the investigations for this study were more thorough than they would have been if communications had not been a focus.

Time Demands on Investigating Officers

As part of the reporting process, IOs were asked to indicate the time spent investigating potential communications problems and completing the reporting forms. Estimates of the additional time required for the procedures used in this study are based on the medians (50^{th} percentiles) of the IO estimates, shown in Figure F-1. For the 482 cases in which communications was not investigated, the median investigation time was 10 minutes and the form completion time was 10 minutes. For the 107 cases in which communications was investigated, the median investigation time was 60 minutes and the form completion time was 30 minutes. Across all 589 cases, the median investigation time was 25 minutes and form completion time was 10 minutes. Thus, our best estimate of the additional time spent by IOs in meeting the investigation and reporting

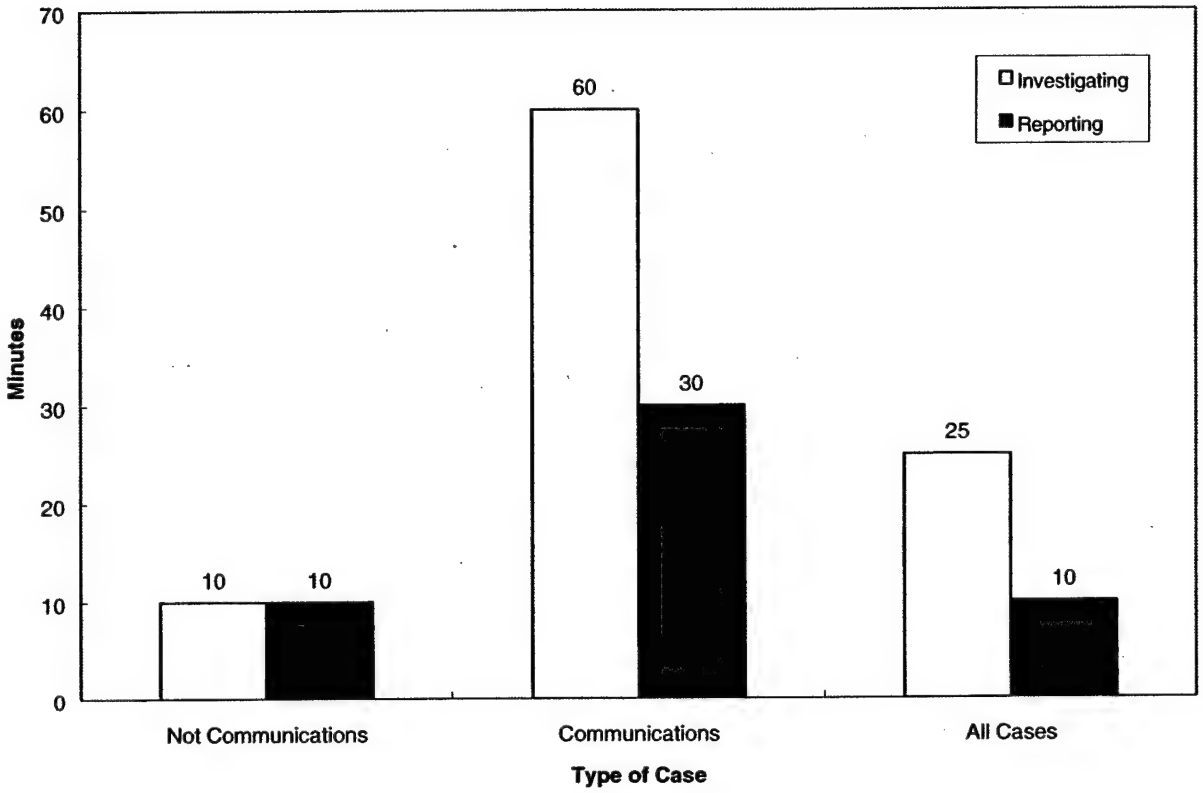

Figure B-1. Median estimated time for casualty case investigation and reporting.

USCG Communications Casualty Investigations Project

MSO Assessment Questionnaire

For the past six to eight months, you have been asked to participate in a project on the investigation and reporting of communications-related information.

This questionnaire is designed to provide you with an opportunity to present your comments and suggestions in regards to the value of this approach to the investigation of human factors and communications-related information.

To facilitate your task when completing this questionnaire, we have attached copies of a) the newsletters, b) the instructions, c) the Casualty Screening and Background Form, and d) the five Communications Reporting Forms.

Your responses are valuable to provide future directions to this project and, as such, your participation is greatly appreciated! Thank you!

1. Background Information

1.1 MSO: ❒ NEWMS ❒ NYCMI ❒ PADMS ❒ PORMS

1.2 Name of Investigating Officer: _____

1.3 Rank: _____

1.4 Position: _____

1.5 When were you assigned to this investigation office? ___/___/___
mm / dd / yy

1.6 When did you initially get involved with this project? ___/___/___
mm / dd / yy

1.7 Approximately how many vessel and personnel injury casualties were assigned to you between September 1st, 1997 and March 31st, 1998? _____

1.8 For approximately how many vessel and personnel injury casualties did you complete the Communications investigations forms (*Casualty Screening and Background form and Communications Reporting Forms*) between September 1st, 1997 and March 31st, 1998?_____

2. Training and Support Materials

2.1 Did you receive the full-day training provided by project staff at your office?

❒ Yes ❒ No *If yes, how would you rate this training on:*

	Poor 1	2	3	4	Excellent 5
a) Explaining why you were completing forms	❒	❒	❒	❒	❒
b) Describing what information you needed to collect	❒	❒	❒	❒	❒
c) Describing how to complete the forms	❒	❒	❒	❒	❒
d) Preparing you for this new role in your job	❒	❒	❒	❒	❒
e) Other _____	❒	❒	❒	❒	❒

2.1b Overall, was the full day training provided by project staff useful or needed?

_____

1 2 3 4 5

not useful at all extremely useful

If you completed this item, please go to item 2.4.

2.2 If you did not receive the initial training provided by project staff, did you receive any training from your co-workers or supervisors at your office?

❒ Yes ❒ No *If yes, please describe the training received:* _____

_____

_____

If yes, how would you rate this training on:

	Poor 1	2	3	4	Excellent 5
a) Explaining why you were completing forms	❒	❒	❒	❒	❒
b) Describing what information you needed to collect	❒	❒	❒	❒	❒
c) Describing how to complete the forms	❒	❒	❒	❒	❒
d) Preparing you for this new role in your job	❒	❒	❒	❒	❒
e) Other _____	❒	❒	❒	❒	❒

If you completed this item, please go to item 2.4.

2.3 a) If you received neither training from project staff nor training from your co-workers or supervisors at your office, how did you acquire the information necessary to complete the project requirements?

_____

_____

b) How would you rate the information that you have acquired in preparing you for this new role in your job?

Poor				Excellent
1	2	3	4	5
☐	☐	☐	☐	☐

2.4 Please provide any recommendations you have for improving the training. Possible items of discussion are: a) content of information presented; b) handouts format in regards to refresher training; c) providing a videotaped training session to replace missed training.

_____

_____

_____

_____

_____

_____

2.5 Did you receive a copy of the instructions for completing the forms?

☐ Yes ☐ No *If yes, please complete the following:*

	Never	Occas-sionally	About Half the Time	Usually	Always
a) How frequently did you use the instructions during your investigation?	☐	☐	☐	☐	☐
b) How frequently did you use the instructions during the preparation of the reporting forms?	☐	☐	☐	☐	☐

If you used the instructions, how would you rate these instructions on:

	Poor				Excellent
	1	2	3	4	5
a) Ease of use	☐	☐	☐	☐	☐
b) Value in conducting the investigation	☐	☐	☐	☐	☐
c) Value in completing the forms	☐	☐	☐	☐	☐

2.6 Did you receive one or more copies of the newsletter, the ***Marine Investigator*** (attached)?

☐ Yes ☐ No *If yes, how would you rate the newsletter on:*

	Poor				Excellent
	1	2	3	4	5
a) Keeping you up-to-date with the project	☐	☐	☐	☐	☐
b) Summarizing the latest procedures to use	☐	☐	☐	☐	☐
c) Answering your concerns and questions	☐	☐	☐	☐	☐

2.7 Overall, was the newsletter '***Marine Investigator***' useful? _____

1 2 3 4 5

not useful at all extremely useful

3. Investigation and Procedures Forms

3.1 What is your understanding of the basic purpose of this project?

_____

_____

_____

3.2 What is your understanding of the purpose of the *Casualty Screening and Background Form* (attached)?

_____

_____

3.3 In completing your investigations for *Casualty Screening and Background Form*, what information did you use to assess whether a casualty was HF-related or not?

_____

_____

3.4 How would you rate the Format of the *Casualty Screening and Background Form* in regards to:

	Poor				**Excellent**
	1	**2**	**3**	**4**	**5**
a) Ease of use	❒	❒	❒	❒	❒
b) Contribution to quality of investigation	❒	❒	❒	❒	❒

3.5 Any suggestions for improvements to the *Casualty Screening and Background Form*:

_____

_____

3.6 What is your understanding of the purpose of the *Communications Reporting Forms* (attached)?

_____

_____

_____

3.7 Which criteria/information did you use to determine if a casualty was communications-related or not?

_____

_____

_____

3.8 How would you rate the Format of *Communications Reporting Forms* in regards to:

	Poor 1	2	3	4	Excellent 5
a) Ease of use	❒	❒	❒	❒	❒
b) Determining communications factors	❒	❒	❒	❒	❒
b) Contribution to quality of investigation	❒	❒	❒	❒	❒

3.9a When it was required in a casualty case, what percentage of time were you able to contact (e.g., phone or on site) the individual(s) directly involved in the casualty? _____%

3.9b How many phone calls did you have to make, on average, in order to reach the individuals directly involved in the casualty? _____

3.10 You spent additional time to fulfill the requirements of this project. We would like to know the averaged time spent on the following tasks:

	Averaged Time Spent
a) Establishing contact with the individual(s) involved by phone or in person	_____
b) Verifying the events leading up to the casualty	_____
c) Finding out if communications was an issue and a contributing factor to the casualty	_____
d) Finding out which factors contributed to the communications breakdown	_____
e) Other_____	_____

3.11 In terms of investigating for communications breakdowns, did you feel that the *Communications Reporting Forms* were incomplete?

❒ Yes ❒ No *If so, what additional information should have been collected?*

_____

_____

3.12 Any suggestions for other improvements to the *Casualty Screening and Background Form* and the *Communications Reporting Forms*?

_____

_____

3.13 Overall, what do you think of the 2-step (*Casualty Screening and Background Form* and *Communications Reporting Forms*) approach to the investigation of communications-related information?

Not useful at all	Not very useful	Useful	Very useful	Extremely useful
❒	❒	❒	❒	❒

Please explain why: _____

_____

4. Benefits and Costs Associated with this Project

4.1 List the benefits, if any, to **you** and the **USCG** of participating in this project:

a) Benefits to you	1.	_____
	2.	_____
	3.	_____
b) Benefits to USCG	1.	_____
	2.	_____
	3.	_____

4.2 List the disadvantages, if any, to **you** and the **USCG** of participating in this project:

a) Disadvantages to you	1.	_____
	2.	_____
	3.	_____
b) Disadvantages to USCG	1.	_____
	2.	_____
	3.	_____

4.3 As of April 1st, 1998, the data collection for this project was terminated, and the forms were no longer required to be filled out. Since then, have you incorporated any of the procedures or forms from this project into your routine investigation of new casualties?

❒ Yes ❒ No

If yes, which elements of the procedures or forms have you been using: _____

_____

_____

If you answered no, indicate why you choose not to use the procedures and forms to the investigation of new casualties: _____

_____

5. Recommendations for Improvement

5.1 How would you rate the value of this approach (procedures and forms) in regards to:

	Poor 1	2	3	4	Excellent 5
a) investigating communications information	☐	☐	☐	☐	☐
b) reporting communications information	☐	☐	☐	☐	☐

5.2 If this information was collected by all Marine Safety Offices for a period of 1 year, how would you consider the ability of this information to enable **you** or the **USCG** to:

	Poor 1	2	3	4	Excellent 5
a) evaluate whether communications was a potential factor to a casualty	☐	☐	☐	☐	☐
b) identify the type (process problem) of communications breakdown	☐	☐	☐	☐	☐
c) identify all the factors contributing to the communications breakdown	☐	☐	☐	☐	☐
d) determine if a casualty was caused by a communications breakdown	☐	☐	☐	☐	☐
e) determine to what extent communications breakdowns occur in the maritime industry	☐	☐	☐	☐	☐
f) enhance the investigation of communications-related factors	☐	☐	☐	☐	☐
g) enhance the investigation of human factors causes of casualties	☐	☐	☐	☐	☐

5.3 Any suggestions for improvements to the investigation and reporting of Human Factors information?

_____

_____

5.4 Any suggestions for improvements to the investigation and reporting of Communications-related information?

5.5 Any suggestions for improvements to the entire process?

5.6 In your opinion, should this approach for investigating communications be expanded to all Marine Safety Office(s) for a longer duration?

❒ Yes ❒ No ❒ Uncertain

Why?

5.7 In your opinion, should this approach be expanded to cover additional human factors topics?

❒ Yes ❒ No ❒ Uncertain

Why?

If so, which human factors topic would you recommend as the next project?

5.8 Please note anything that you feel is important in regards to this project but has not been addressed by this survey.

We recognize the burden that we have imposed on you over the last 9 months and we would like to thank you and mention that we have appreciated your collaboration and efforts in this project.

Thank you!
Marvin and Mireille as well as Anita, Myriam, and Brooke from the USCG R&D

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APPENDIX C

Selected Findings for Minor and Critical Vessel Casualties Combined

In this study, *minor* vessel casualties were defined as those involving limited property damage with no risk to the loss of the vessel or personnel injury. *Critical* vessel casualties were defined as those involving significant damage to the vessel or property, or in which the safety of the crew was at risk. *Minor* vessel casualties were defined as those that exclusively involved a temporary loss of vessel steering or propulsion. Minor vessel casualties comprised 106 of the 589 total casualties investigated and reported in this study. Due to their relatively less severe nature, the minor vessel casualties were excluded from many of the analyses in the main body of this report. For the purpose of comparison, however, the 106 minor vessel casualties are included among the 267 critical vessel casualties in the results below.

Results of Criticality and Human Factors Screening

Figure C-1 summarizes the criticality and human factors screening results for the 486 vessel casualties investigated and reported during this study. Beginning with the criticality screening depicted in the figure, 219 vessel casualties were determined to be non-critical and 267 cases were determined to be critical. For the human factors screening applied to the 267 critical vessel casualties, 185 cases were determined not to have a direct human factors contribution and 82 cases were determined to have a direct human factors contribution.

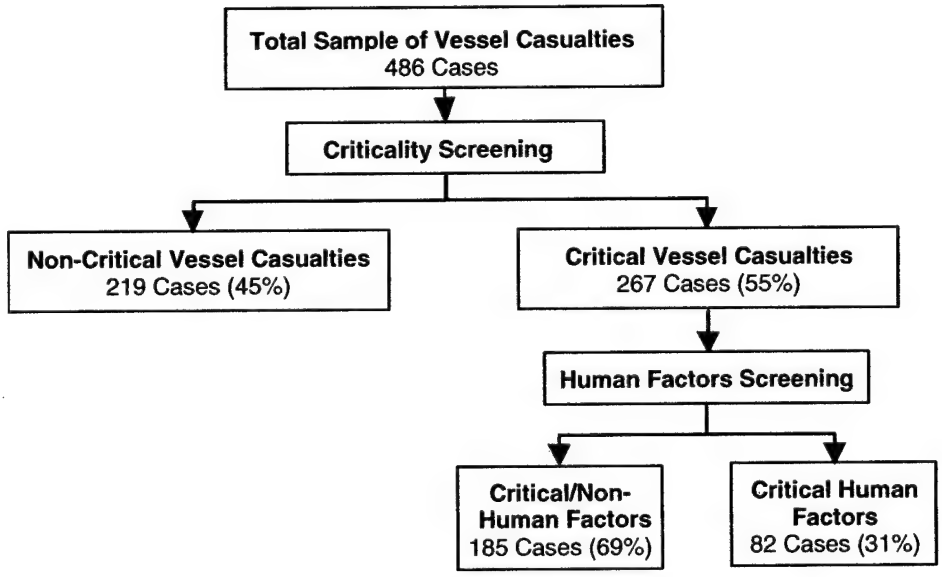

Figure C-1. Summary of vessel casualty criticality and human factors screening.

Human Factors Contributions to Vessel Casualties

In considering the general contribution of human factors to vessel casualties, two topics were addressed. First, the specific types of vessel casualties with a human factors contribution were examined. Second, the vessel types involved in these casualties were considered. These analyses included all 267 critical vessel casualties.

Types of critical vessel casualties with human factors contribution. Figure C-2 presents the frequency of vessel casualty types with and without a direct human factors contribution for the 267 critical vessel casualties identified in this study. Direct human factors contributions were most prevalent in collisions (92 percent), allisions (62 percent), groundings (56 percent), and foundering and sinking casualties (47 percent). In general, these are the types of casualties in which an individual's action, decision, or inaction can be tied directly to inadequate vessel navigation or handling. In contrast, human factors are found to have much lower rates of direct contributions in structural failures (30 percent), fires (25 percent), and all four types of equipment failures (12 percent).

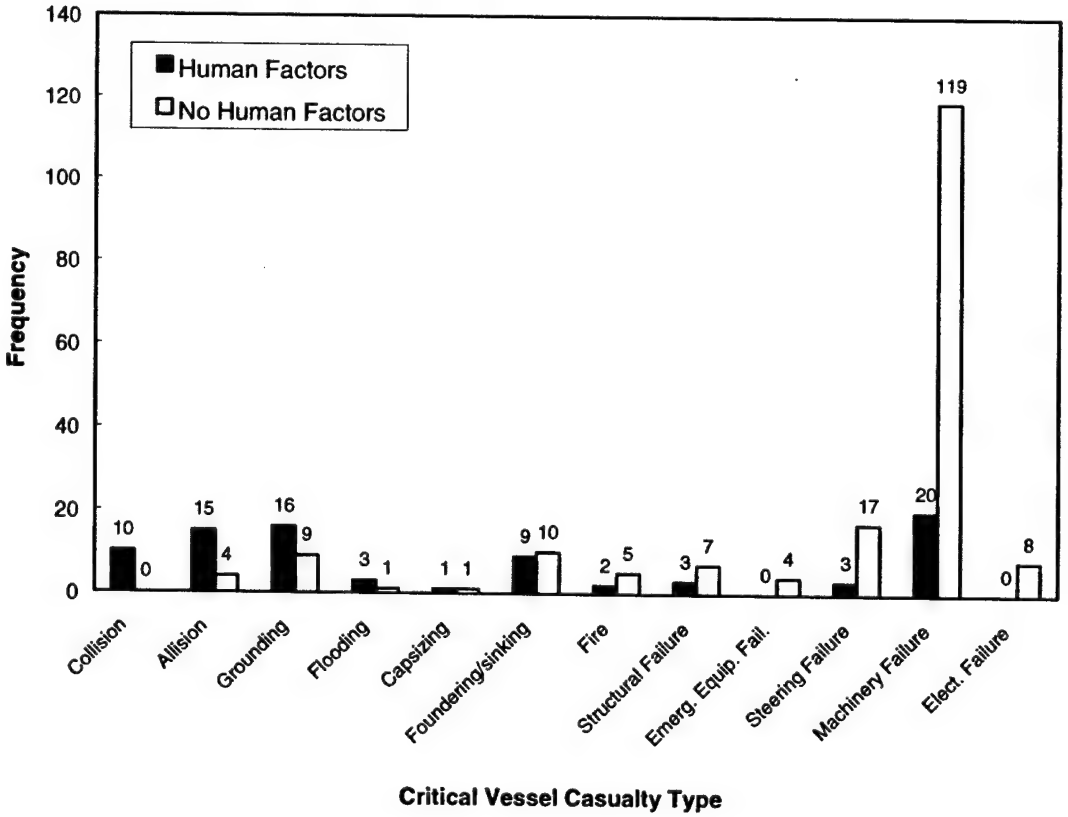

Figure C-2. Frequency of critical vessel casualty types with and without a direct human factors contribution (N=267).

Vessel types involved in critical vessel casualties with a human factors contribution. Figure C-3 presents the frequency of vessel types involved in vessel casualties with and

without a direct human factors contribution for the 267 critical vessel casualties identified in this study. Here, the findings indicate relatively low rates of human factors contributions to vessel casualties aboard passenger vessels (19 percent) and fishing vessels (19 percent). Among those vessel types with an adequate number of vessel casualties to interpret trends in human factors contributions, there is a relatively higher rate of human factors contribution aboard the tugs, barges, and towboats (41 percent).

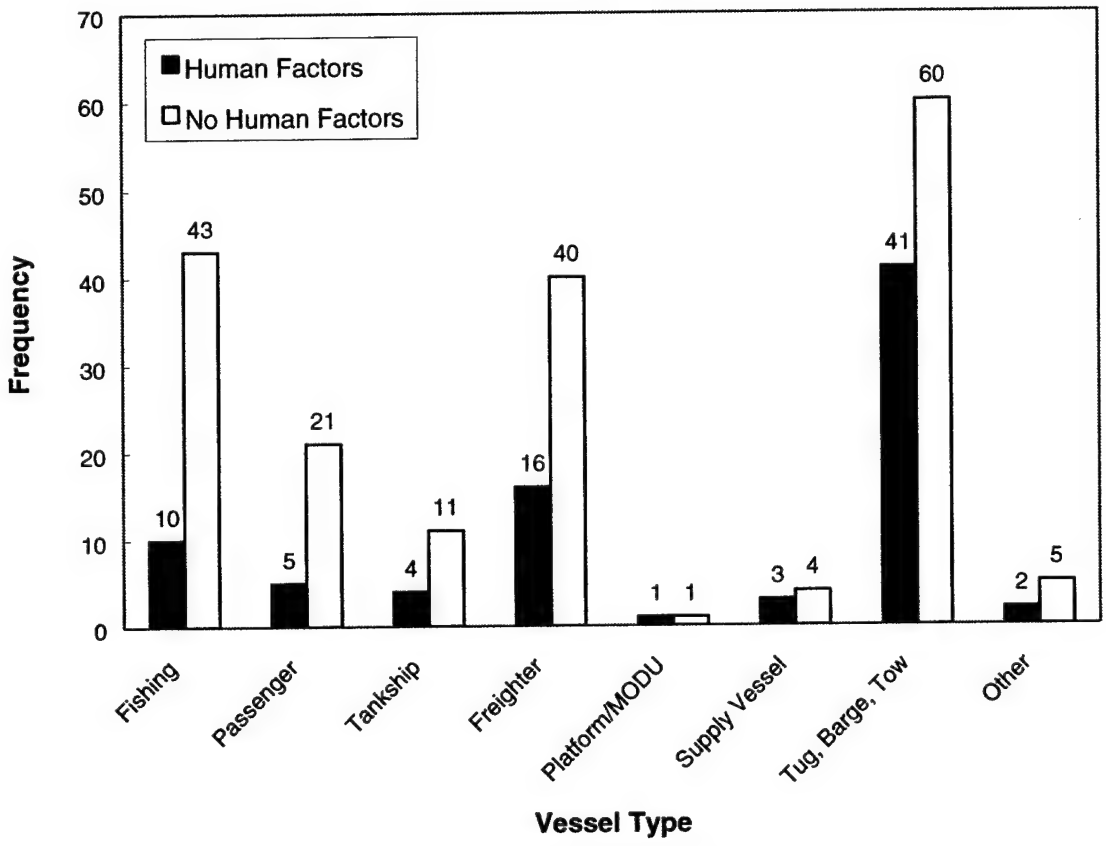

Figure C-3. Frequency of vessel types in critical vessel casualties with and without a direct human factors contribution (N=267).

Characteristics of Vessel Casualties with a Communications Contribution

The separate discussions of communications problems in vessel casualties address four topics:

- Communications problem areas across five communications sub-topics.
- Most frequently identified communications problems within selected communications sub-topic/problem area combinations.
- Frequency of contributing factors to communications problems.
- Most frequently identified contributing factors within selected communications problems.

Prevalence of Communications Problems

Figure C-4 summarizes the results of the screening for potential communications contribution and the final determination regarding the contribution of communications to each vessel casualty. Of the 82 critical human factors vessel casualties, 48 cases were determined to have a potential for communications involvement. Of the 48 critical vessel casualties with a potential for a communications problem, 37 (77 percent) were determined to have one or more communications problems contributing to the casualty.

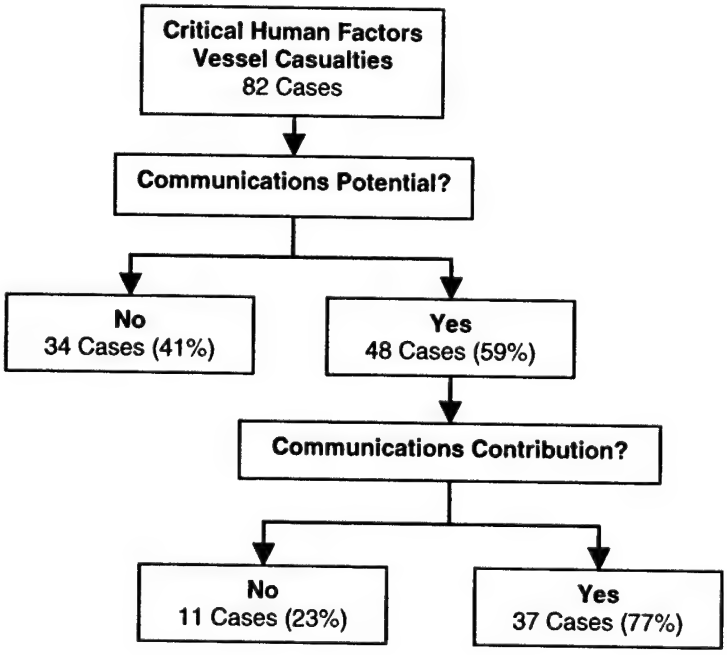

Figure C-4. Summary of critical vessel casualty communications potential screening and communications investigation results.

Vessel Casualties and Communications Problems

The following discussion of vessel casualties and communications problems addresses problems and contributing factors identified among 37 critical vessel casualties, including three cases that involved both vessel and personnel injury casualties. Multiple communications problems were identified for most casualties. For example, 92 separate problems were identified among the 37 critical vessel casualties with communications problems. Because of this, the discussion focuses on the relative prevalence of different problems and contributing factors, rather than the percentage of cases in which different types of problems were cited.

Communications problem areas in vessel casualties. Among the 37 critical vessel casualties in which communications problems were identified as a contributor, IOs identified 92 separate instances of communications problems. Figure C-5 presents the distribution of these 92 problems across the five communications sub-topics (vessel-vessel, pilot-bridge, vessel-shore authority, crew-crew, and vessel-shore worker) and the four communications process areas (prepare and send message, message transmission, receive and interpret message, and act on message). This figure depicts several findings worthy of note. First, there is a definite clustering of problems within communications processes. The *Prepare and Send Message* process has the majority of problems associated with it, with 59 (64 percent) of the total set of 92 cited problems. The *Receive and Interpret Message* process has 16 problems associated with it, or 17 percent of the total set of cited problems.

The second noteworthy characteristic of Figure C-5 is that a subset of communications process and sub-topic combinations represents most of the cited problems. The seven most frequently cited problem areas in Figure C-5 represent 78 (85 percent) of all cited problem areas. These seven areas constitute potential opportunities for improving communications processes to reduce the risk of these vessel casualties.

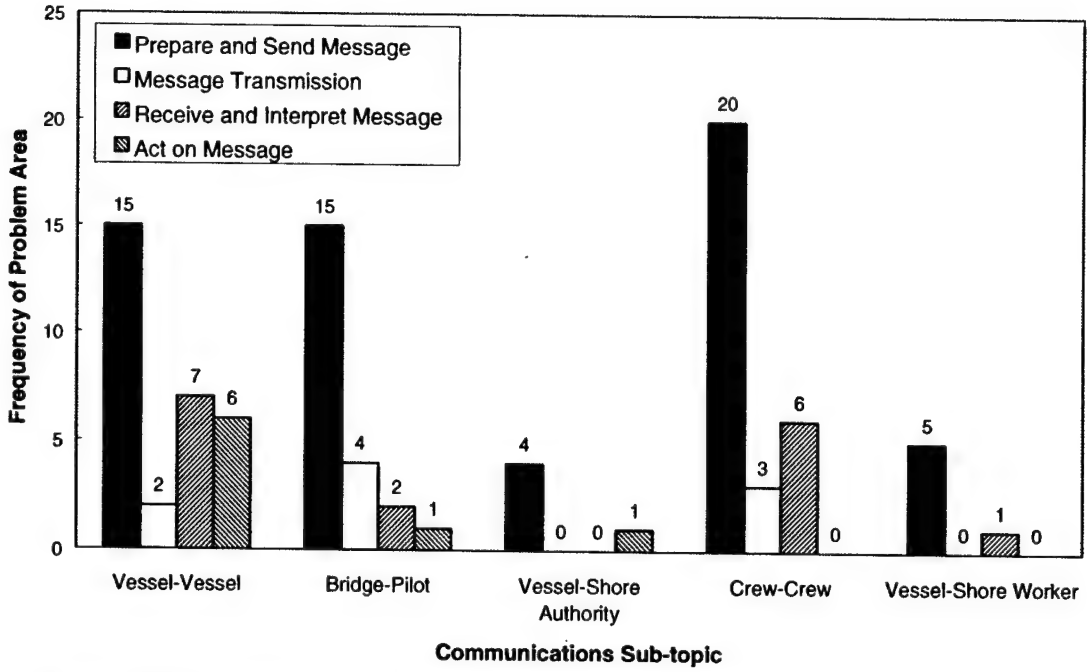

Figure C-5. Critical vessel casualties – Communications problem areas across five communications sub-topics.

Most frequently identified communications problems in vessel casualties. Table C-1 presents the frequency with which 78 specific communications problems were cited by IOs within the seven most prevalent problem areas in critical vessel casualties. In this table, the seven problem areas are listed in order of their frequency, as are the specific problems listed under each area. Note that an IO could cite multiple problems within a casualty. A number of specific findings are apparent in reviewing Table C-1. First, the *Did not communicate* problem was the most prevalent within *Prepare and Send Message* problems, especially among crewmembers on the same vessel. Second, a fairly broad range of specific problems in the *Prepare and Send Message* process were cited by IOs. Third, *Did not monitor communications* was the most prevalent problem associated with *Receive and Interpret Message* problems. Finally, a general disregard for previous communications was indicated as the problem (*Took no action* and *Action was not in accordance with agreement*) when *Act on Message* was cited as the general problem area.

Table C-1. Critical vessel casualties – Most frequently identified communications problems within selected communications sub-topics.

Communications Sub-topic – Communications Problem Area Specific Communications Problem	Frequency
Crew-Crew – Prepare and send message	
Did not communicate	13
Communicated ambiguous, incorrect, or incomplete information	3
Did not request information	3
Did not question other's actions or assert interpretation of situation	1
Vessel-Vessel – Prepare and send message	
Did not communicate	4
Did not question other's actions or assert interpretation of situation	4
Did not request information	3
Communicated ambiguous, incorrect, or incomplete information	2
Did not send information in a timely manner	2
Pilot-Bridge – Prepare and send message	
Did not communicate	6
Did not question other's actions or assert interpretation of situation	3
Communicated ambiguous, incorrect, or incomplete information	2
Did not request information	2
Did not send information in a timely manner	2
Vessel-Vessel – Receive and interpret message	
Did not monitor communications	5
Did not listen to complete message	1
Did not acknowledge information reception	1
Vessel-Vessel – Act on message	
Took no action	4
Action was not in accordance with agreement	2
Crew-Crew – Receive and interpret message	
Did not interpret the information correctly	3
Did not verify the validity or accuracy of the information	2
Did not acknowledge information reception	1
Pilot-Bridge – Message Transmission	
Message not transmitted	4

Frequency of contributing factor areas to communications problems in vessel casualties. In determining how communications contributed to a casualty, IOs were asked to choose from a list of 34 individual contributing factors, which were divided into seven areas. Investigating Officers identified 171 individual factors that contributed to specific communications problems among the 37 critical vessel casualties in which communications problems were identified as a contributor. Figure C-6 presents the frequency with which IOs identified general contributing factor areas across the four communications processes for these critical vessel casualties. As seen in the figure, 98 of the total 171 contributing factors identified (57 percent) are associated with assumptions of those communicating. In addition, 135 of the total 171 identified factors (79 percent) are clustered within five of the 28 possible combinations of contributing factor areas and communications processes.

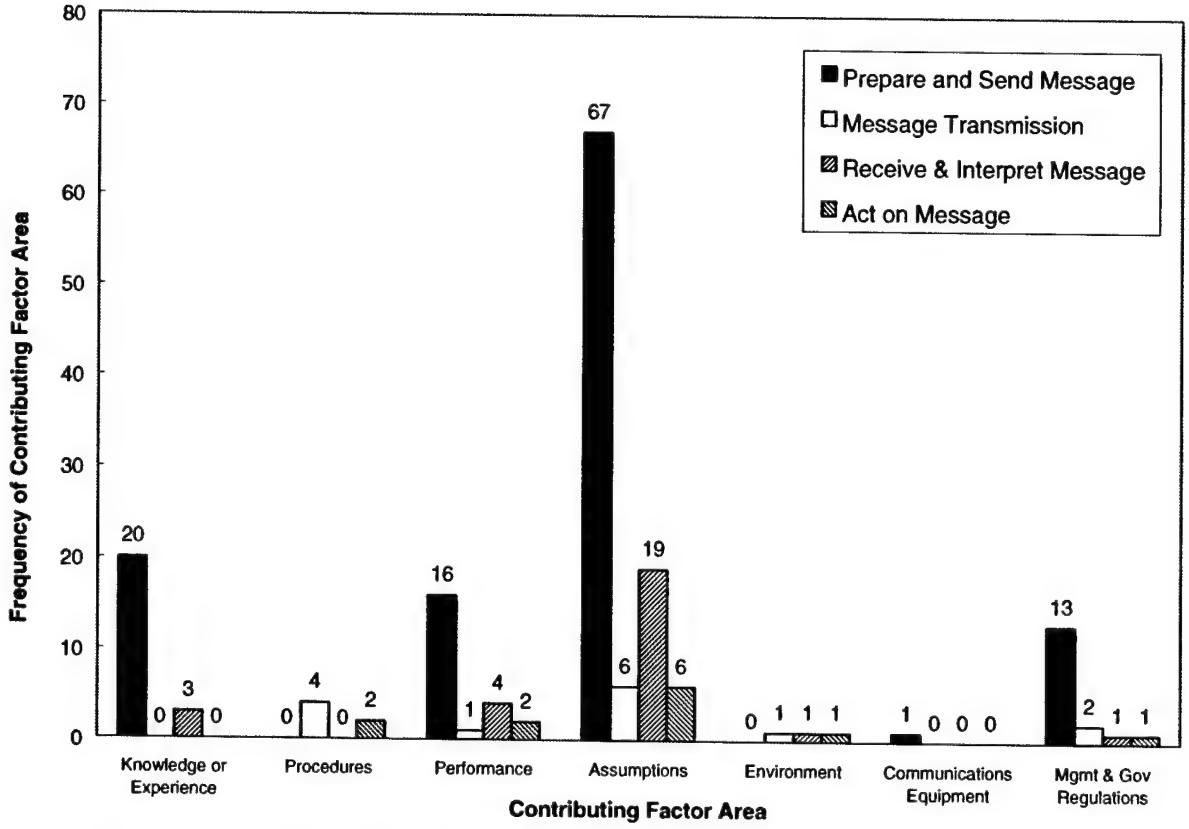

Figure C-6. Critical vessel casualties – Frequency of contributing factor areas to communications problems.

Most frequently identified contributing factors to communications problems in vessel casualties. Table C-2 provides a list of the specific contributing factors identified in each of the five most frequently cited areas in Figure C-6. Note that IOs identified a total of 135 specific contributing factors within these five problem areas. Review of this table provides a number of insights regarding the factors contributing to these communications problems. First, many of the problems associated with *Assumptions* in *Prepare and Send Message* stem from the contributing factor *Assumed there was no need to communicate* (31 instances). Second, a frequent problem associated with knowledge or experience in *Prepare and Send Message* is *Limited English skills or knowledge*. Third, there was a broad range of factors contributing to problems of assumptions in *Receive and Interpret Message*. Fourth, factors contributing to *Performance* problems in *Prepare and Send Message* involved both attitude (*Not willing to communicate*) and conflicting job requirements (*Distracted or interrupted by other tasks* and *individual not at workstation*). Finally, a lack of regulation and/or procedures was seen as a contributing factor in *Management and Policy* problems in *Prepare and Send Message.*

Table C-2. Critical vessel casualties – Most frequently identified contributing factors within selected communications processes.

Communications Process – Contributing Factor Area Specific Contributing Factor	Frequency
Prepare and send message – Assumptions	
Assumed that there was no need to communicate	31
Incorrect interpretation of the situation	11
Assumed incorrectly that other party knew the information	10
Assumed that individual in charge recognized the problem	9
Other	3
Assumed lack of response as implicit (silent) confirmation	3
Prepare and send message – Knowledge or experience	
Other	6
Limited English skills or knowledge	5
Lack of common language	3
Inadequate knowledge of correct communications protocol	2
Inadequate knowledge of regulatory requirements	2
Improper use of standard marine technical vocabulary	1
Inadequate knowledge of company procedures or policies	1
Receive and interpret message – Assumptions	
Assumed that there was no need to communicate	4
Assumed that individual in charge recognized the problem	4
Assumed incorrectly that other party knew the information	3
Incorrect interpretation of the situation	3
Other	3
Assumed lack of response as implicit (silent) confirmation	2
Prepare and send message – Performance	
Not willing to communicate	6
Distracted or interrupted by other tasks	4
Other	3
Not willing to challenge authority	2
Individual not at workstation	1
Prepare and send message – Management and regulations	
No regulatory requirement to communicate	7
Inadequate Standard Operating Procedures	5
Other	1

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APPENDIX D

Revised Communications Problem Screening and Investigation Tools

One of the final activities of this study was to develop a set of tools that IOs could use to investigate casualties resulting from communications problems. The objective of this activity was to develop two tools. The first tool was to be a streamlined, one-page form that IOs could use to determine whether a given casualty appears to have a communications cause. The second tool was to be a more extensive form, or set of forms, that would aid IOs in collecting information that could be used to specify causal links explaining "why" the casualty occurred. This appendix presents the proposed tools resulting from efforts to meet this objective.

After completing the data analyses and interpreting the study findings, we considered the most appropriate content and format for this set of tools. Three principles guided our development efforts, as summarized below.

1. The results clearly indicated that the set of five screening questions used in the study were effective in identifying casualties resulting from a communications problem – 76 percent of all casualties identified as requiring effective communications subsequently were determined to have resulted from a communications problem. Therefore, these five questions could provide the basis for the initial screening of cases.

2. The five communications sub-topic forms used in the study (vessel-vessel, bridge-pilot, vessel-shore authority, crew-crew, and vessel-shore worker) each had one unique section that requested consideration of specific communications causes. This section was useful in focusing investigators' attention on specific communications issues. It was determined that these sections should be incorporated into the screening procedure.

3. Most of the content of the five communications sub-topic forms was redundant across forms. A single page specified communications processes, problems, and contributing factors for investigators to consider and report during their investigation. This structure proved to be highly useful in identifying the particular problems and contributing factors of communications problems within and across the five communications sub-topics. Therefore, it was determined that this content and format should be largely retained in the final set of tools.

In developing our proposed investigation tools, we found that a one-page screening form and a one-page "in-depth" form that were basically self-contained met our objectives. Because each of these forms is one page, we thought it would be convenient if the two forms were printed front-to-back on the same sheet of paper.

After completing the forms, we determined that it would be best to introduce investigators to the general model that was used as the basis for the procedures, to provide some empirical support for the use of the procedures, and to give an easy-to-follow summary of the investigation steps. Therefore, we prepared a set of instructions intended to accompany the forms.

The completed forms were sent to selected MSOs for their review and comment. The forms were judged to be clear and easy to follow. However, our initial set of instructions was judged to be "too long and wordy." In accordance with MSO input, we decreased the length and verbosity of our instructions.

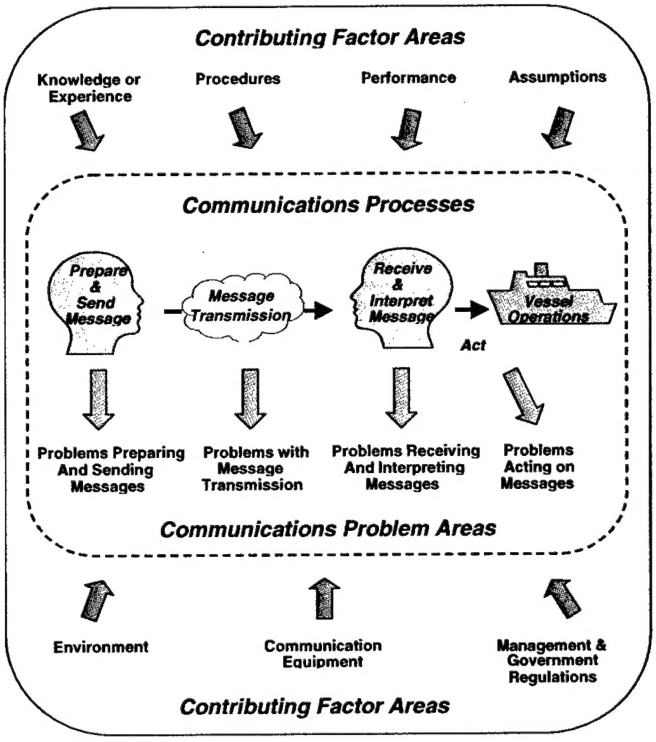
Following are the proposed instructions and forms.

Instructions for Investigating Communications Problems in Marine Casualties

These instructions provide an aid in using the *Communications Problems Screening and Investigation Procedures* to investigate communications problems in vessel and personnel injury casualties.

Background

These procedures were developed as part of a Coast Guard study of how best to investigate and report on communications problems. As part of that study, a general model of communications problems was developed, shown in the adjacent figure. This model divides communications into four *Communications Processes* (prepare and send message, message transmission, receive and interpret message, and act on message) and four corresponding *Communications Problem Areas*. The model further identifies seven *Contributing Factor Areas* that can cause or contribute to communications problems.



Basis

Investigation procedures based on this model were developed and then applied by Investigating Officers as part of the study. During the study, investigators screened casualties to identify those that required effective communications to support safe operations. Of those casualties identified as requiring effective communications, 76 percent were subsequently found to have a communications problem that contributed to the casualty. Following their initial screening of cases, investigators conducted in-depth investigations and analyses of selected casualties to identify specific communications problems and contributing factors. Investigating Officers were able to use the procedures to reliably identify communications problem areas and specific factors contributing to the casualties. Overall, the study found that 18 percent of critical vessel casualties and 28 percent of critical personnel injuries had a communications problem that contributed to the casualty.

Instructions

The present procedures have been developed on the basis of the research study outlined above. Step 1 is conducted to identify if there was a potential for a communications problem to have contributed to the casualty. This step identifies casualties where there is a 76 percent probability that ineffective, inappropriate, or a lack of communications contributed to the casualty, according to the results of the research study.

Step 1: Review the five conditions, check any that apply, and identify the type(s) of communications that should be further analyzed (vessel-vessel, bridge-pilot, vessel-shore authority, crew-crew, and vessel-shore worker).

The remaining steps call for a further investigation of the specific communications causes that contributed to the casualty. Complete Step 2 to identify the specific communications causes, if any. Complete Step 3 to document your conclusions regarding the type of communications that contributed to the casualty.

Step 2: For each communication type identified in Step 1, consider the actions in which ineffective, inappropriate, or a lack of needed communications could have contributed to the casualty.

Step 3: Check the types of communications that likely contributed to this casualty and complete Step 4 for each type checked.

Use Step 4 as an aid in investigating and reporting any communication types identified in Step 3.

Step 4: For this step, it will typically be necessary to contact individuals involved in the casualty to determine the events leading up to the casualty, specific communications problems that occurred, and the factors that contributed to these problems. When the investigation and Step 4 have been completed, the results of your investigation and analysis can be incorporated into your MCDD, MCNS, and MCHF.

Communications Problem Screening and Investigation Procedures

*Please refer to the **Instructions for Investigating Communications Problems in Marine Casualties** for a summary of the background and basis for these procedures, as well as general instructions for their use.*

Step 1: Was there a potential for a communications problem contributing to the casualty?

Review the following casualty conditions, check ☑ all that apply, and note the corresponding communication type(s) for further review in Step 2. If no conditions apply, communications were likely not required in the situation.

Casualty Condition	Communication Type
❑ Two or more vessels were involved in this casualty.	Vessel-Vessel
❑ There was a pilot (other than a member of the vessel's crew) responsible for navigation of the ship.	Bridge-Pilot
❑ The vessel was navigating in an area under the supervision of a VTS operator, a bridge tender, a lockmaster, or a light operator.	Vessel-Shore Authority
❑ Two or more crewmembers who were directly involved in this casualty were working together, or this casualty could have been prevented if someone had shared additional information with another crewmember.	Crew-Crew
❑ The casualty occurred during coordination of activities between the vessel and shore-based personnel (e.g., dock worker, crane operator, or vessel agent).	Vessel-Shore Workers

Step 2: What specific communications actions contributed to the casualty?

Check ☑ all actions in which ineffective, inappropriate, or a lack of needed communications may have contributed to the casualty. Note any other causes not listed. If any potential causes are identified, continue with Steps 3 and 4.

Vessel-Vessel Communication Problems

- ❑ Vessel communication using a VHF radio system
- ❑ Vessel communication using sound signals
- ❑ Vessel communication using visual signals
- ❑ Vessel communication using some other means
- ❑ Other:

Bridge-Pilot Communication Problems

- ❑ Pilot request for vessel and situation information
- ❑ Bridge crew warned pilot of equipment malfunction
- ❑ Pilot brief to bridge crew on navigation plan
- ❑ Pilot brief to bridge crew on operating conditions
- ❑ Pilot update to bridge crew on change in plans
- ❑ Crew update to pilot of change in situation
- ❑ Other:

Vessel-Shore Authority Communication Problems

- ❑ Vessel call to shore authority
- ❑ Shore authority advisory to vessel of situation
- ❑ Vessel statement of intentions to shore authority
- ❑ Shore authority acknowledgement of vsl intentions
- ❑ Other:

Crew-Crew Communication Problems

- ❑ Use of direct and verbal conversation
- ❑ Use of hand signals
- ❑ Use of communications devices
- ❑ Use of written communications
- ❑ Other:

Vessel-Shore Worker Communication Problems

- ❑ Use of direct and verbal conversation
- ❑ Use of hand signals
- ❑ Use of communications devices
- ❑ Use of written communications
- ❑ Other:

No Potential Communication Problems Identified

- ❑ Further investigation failed to support communications as a causal factor

Step 3: Which of the following types of communication contributed to this casualty?

Based on the response to Step 2, check ☑ the types of communication, if any, that likely contributed to this casualty and complete Step 4 for each type checked.

- ❑ Vessel-Vessel Communications
- ❑ Bridge-Pilot Communications
- ❑ Vessel-Shore Authority Communications
- ❑ Crew-Crew Communications
- ❑ Vessel-Shore Worker Communications
- ❑ N/A--no communication problems identified

(Continue on reverse)

Step 4: What specific communications problems and factors contributed to this casualty?

For each type of communication checked in Step 3, check ☑ all communications problems that contributed to the casualty. For each problem identified below, list at least one contributing factor from the list below by indicating its corresponding identification number (#1-41). For example, ☑ Did not request information...3, 15, 28.

Communications Process	Communications Problem	Contributing Factor (see 1 – 41 below)
Prepare & Send Message (includes spoken and written communications, hand and sound signals)	❒ Did not communicate	___ ___ ___
	❒ Communicated ambiguous, incorrect, or incomplete information	___ ___ ___
	❒ Did not question others' actions or assert own interpretation of situation	___ ___ ___
	❒ Did not request information	___ ___ ___
	❒ Did not send information in a timely manner	___ ___ ___
	❒ Sent different information than intended	___ ___ ___
Message Transmission	❒ Message was not transmitted	___ ___ ___
	❒ Message was interrupted	___ ___ ___
	❒ Message was incomprehensible	___ ___ ___
Receive & Interpret Message	❒ Did not monitor communications	___ ___ ___
	❒ Did not listen to complete message	___ ___ ___
	❒ Did not acknowledge information reception	___ ___ ___
	❒ Did not interpret the information correctly	___ ___ ___
	❒ Did not verify the validity or accuracy of the information	___ ___ ___
Act on Message	❒ Took no action	___ ___ ___
	❒ Action was not in accordance with agreement	___ ___ ___
Others:		___ ___ ___

Knowledge or Experience

1. Improper use of signaling techniques (hand, light, flag)
2. Improper use of standard marine technical vocabulary
3. Inadequate knowledge of company procedures or policies
4. Inadequate knowledge of correct communications protocol
5. Inadequate knowledge of regulatory requirements
6. Limited English skills or knowledge
7. Language difficulty (e.g., enunciation, strong accent)
8. Lack of common language
9. Other: _____

Procedures

10. Did not carry communications equipment on person
11. Did not operate the communications equipment correctly
12. Selected incorrect communications channel or frequency
13. Selected incorrect communications device
14. Other: _____

Performance

15. Distracted or interrupted by other tasks (e.g., high workload)
16. Forgot information or intended actions
17. Tired or sleepy
18. Individual not at work station
19. Not willing to challenge authority
20. Not willing to communicate
21. Other: _____

Assumptions

22. Assumed that there was no need to communicate
23. Assumed lack of response as implicit (silent) confirmation
24. Assumed incorrectly that other party knew the information
25. Assumed that individual in charge recognized the problem
26. Confusion regarding who was communicating
27. Confusion regarding who was in charge of situation
28. Incorrect interpretation of the situation
29. Other: _____

Environment

30. Excessive ambient noise
31. Excessive electronic or atmospheric disruption of signal
32. Excessive traffic (i.e., too many users, too lengthy) on the assigned communications channel
33. Other: _____

Communications Equipment

34. Communications equipment malfunction
35. Communications equipment not available
36. Communications equipment turned off
37. Other: _____

Management and Government Regulations

38. No regulatory requirement to communicate
39. Not part of individual's job description or responsibilities
40. Inadequate Standard Operating Procedures
41. Other: _____

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